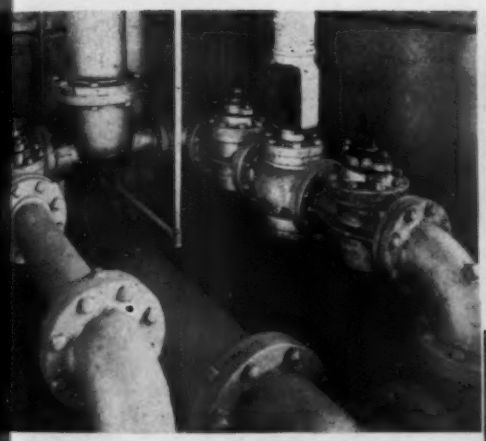
145, No. 2 August, 1936 Price 25c

AMERICAN GAS JOURNAL

NORDSTROM



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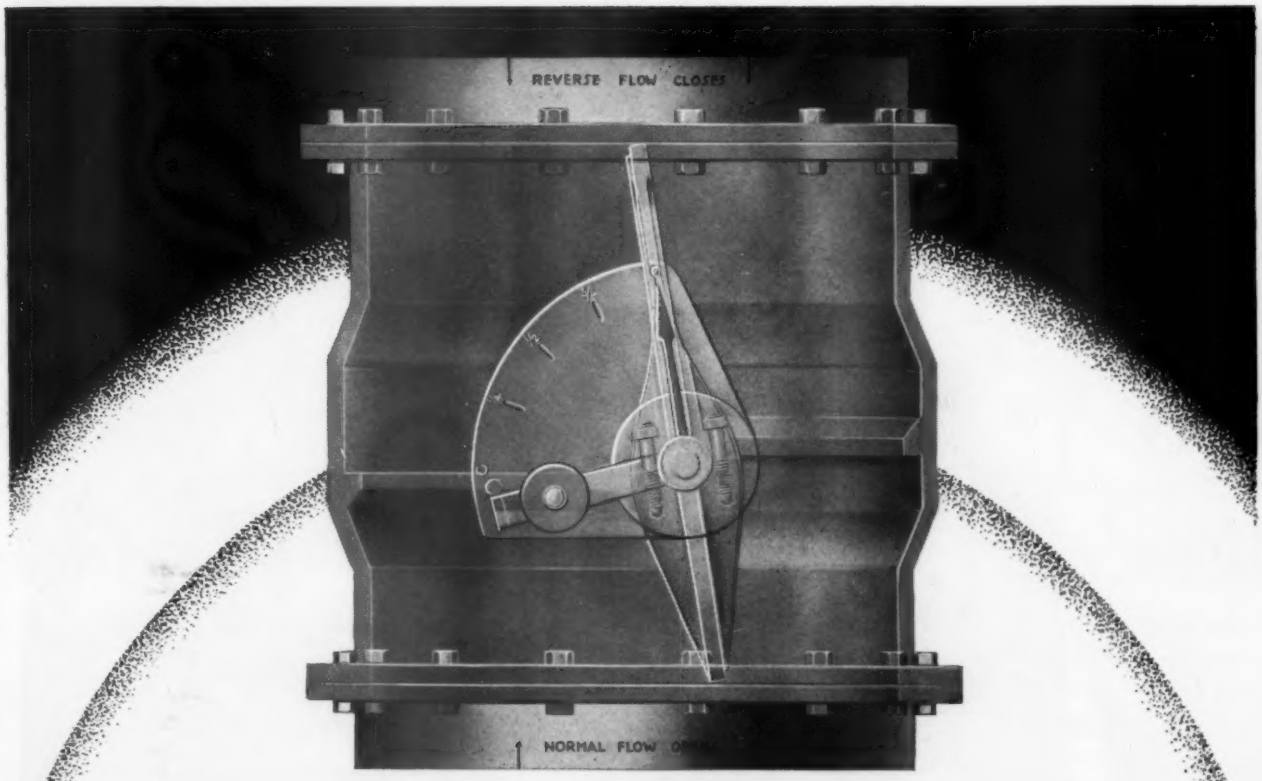

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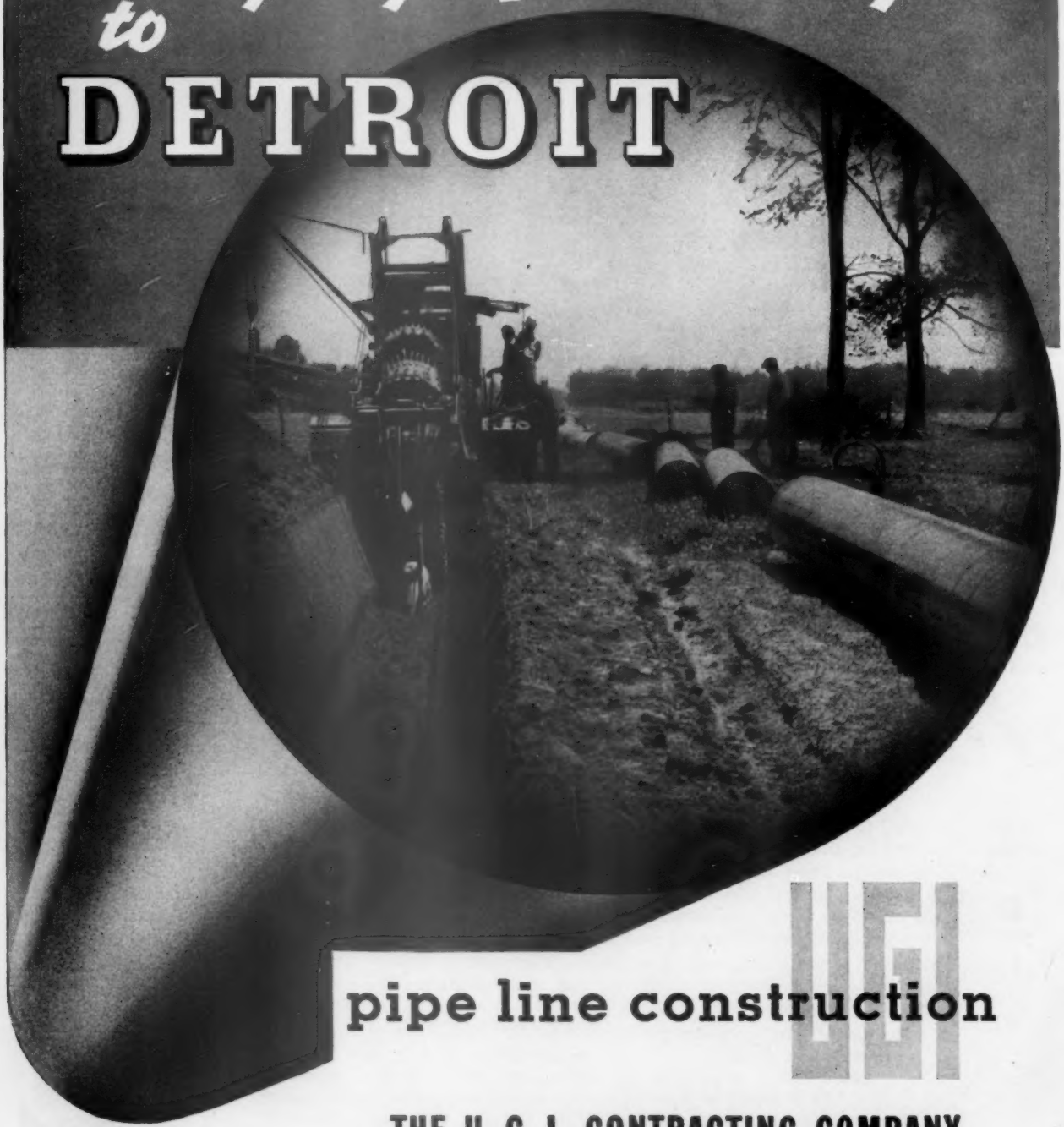

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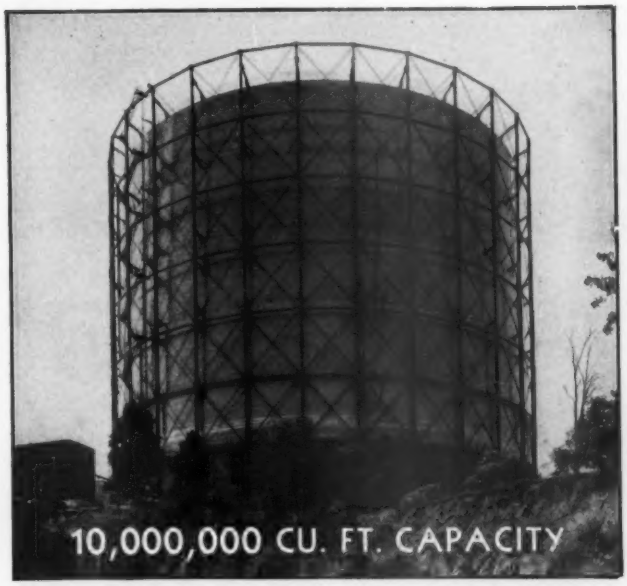

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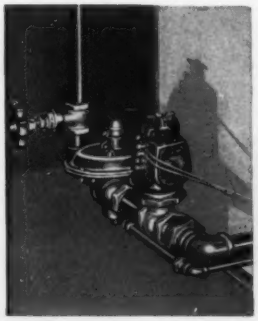
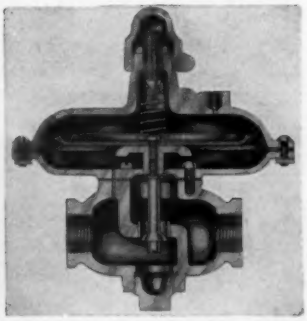


Actual installation of Reynolds Furnace Regulator.



Cross-sectional view of New Reynolds Refrigeration Regulator. *Note* simplicity of construction, ruggedness and fool-proof design.

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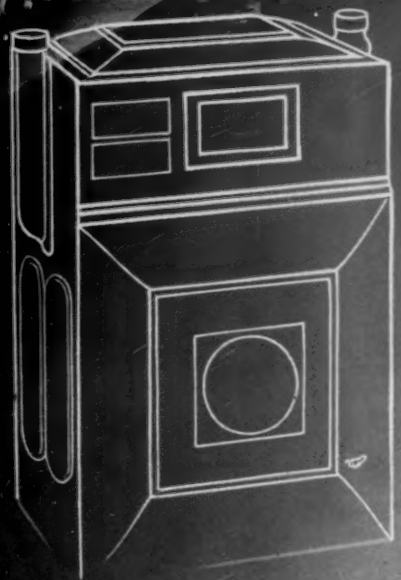

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AUG 13 1936

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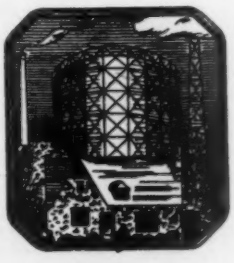

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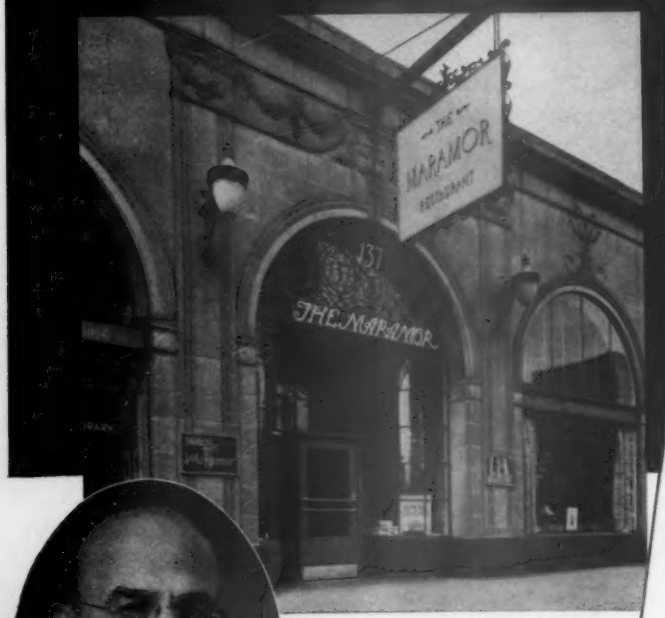

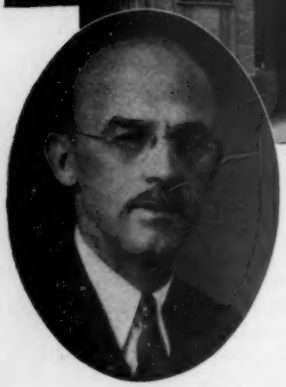

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AUGUST 1936

AMERICAN GAS JOURNAL

VOLUME 145 NO. 2

Domestic Gas Utilization

Range Division

Top Burners—Part III

By **Charles W. Merriam, Jr.**

Manager, Lynchburg Gas Company, Lynchburg, Virginia.

THE functions of the Sales and Service Departments of the Gas Industry are by their very nature somewhat overlapping. Certain it is that in service work involving public contacts a sprinkling of those personal persuasive powers which are part and parcel of sales ability, is a decided asset to fitter or complaint man. Doubted by but few is the fact that a rudimentary knowledge of service department routine and methods increases the value of a salesman to his company, as well as to himself. Furthermore, salesman familiarity with the fundamental problems and their remedies incident to everyday adjusting and servicing jobs constitutes firm ground upon which customer confidence can be built up. Stimulating customer confidence through pleasing contacts with well-informed gas representatives definitely enhances sales volume.

In the average gas property, by far the greatest number of service calls are classified under the general heading of "top burner adjustment." This condition is not necessarily due to any inherent weakness in burner design or construction, or for that matter, to improper gas. The secret of this situation is that the present backbone of the business is the domestic cooking load. In the normal range, at least 75% of the gas used is consumed through the top burners. Thus, a substantial part of service department time is devoted to the adjustment of domestic range top burners. Although the policy of some companies does not allow retail salesmen to make actual mechanical adjustments on consumer appliances, a comprehension of the principles involved permits salesmen to at least distinguish between good and bad adjustments. Such knowledge permits an intelligent recommendation to the service department. Understanding of the differences between *right and wrong* will allow explanations by the salesmen that clear up many consumer misunderstandings, thus eliminating in many instances the necessity for a service call. The inevitable conclusion is that salesmen could profit much by grasping a basic understanding of the range top burner and the simpler problems incident to its successful design and satisfactory operation.

The requirements of a top burner on a domestic gas range serving the interests of the user to the best advantage may be summed up generally as follows:

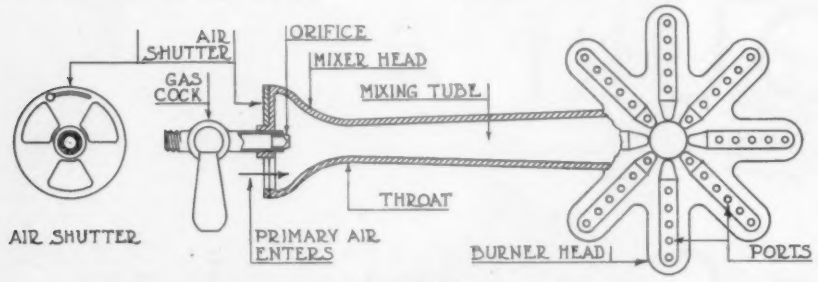
1. Ignition rapid and positive
   (a) Without flash-back in burner head or tube.
   (b) Without flame lifting away from burner ports.
   (c) With sure travel from port to port of burner head.
2. Complete combustion without
   (a) Carbon monoxide gases.
   (b) Carbon soot.
3. Efficient combustion without too great "excess secondary air."
4. Sufficient rate of heat input to perform the work when and as desired.
5. Even distribution of heat for standard utensils.
6. Burner flexibility, permitting turn down to point at least as low as 20% of maximum rating without flash-back or easy extinguishment.

A burner not complying with each and every one of the foregoing is faulty in either design, adjustment, or in both. Likelihood, however, of basic difficulties in design of standard domestic burners is exceedingly remote, due to the exacting standards of the A. G. A. Laboratory and to the highly competitive nature of the stove field.

The art of burner design and the adaptation of such to the inherent limitations of foundry and machine practice introduce complications of a high order of involvement to be tampered with only by the experienced professional[1]. Despite the intricacies incident to the original planning and execution of a new burner model, there are certain inherent principles wholly within the grasp of less specialized gas men. In fact, the simple adjustment of an ordinary top burner presupposes a working knowledge of the *whys and wherefores* of a sort that any well trained service man considers as virtually the beginning of the alphabet. This understanding of fundamentals could with benefit to all concerned be common property to the sales department.

First, let us get an overall picture of a complete burner by examining the accompanying drawing of a so-

called star type of burner together with its description of operation. Inspection of this drawing reveals that the essential elements of a domestic star burner are as follows:



GAS BURNER
("Star" Type)

Turning the gas cock on so that the handle is parallel to the length of the burner permits gas to flow through the gas orifice at a high velocity. Emerging in a rapidly moving jet gas leaves the orifice in a stream whose direction should be exactly that of the center line of the mixing tube.

The mixing head is flared out as shown in such a manner that the suction created by the fast flowing gas from the orifice pulls in air through the so-called primary air shutter affixed to the entrance. The gas and primary air (i. e. air mixed with the gas previous to burning) start mixing in the throat and continue down the length of the mixing tube into the burner head. Three mechanical adjustments are possible, viz., (1) the gas cock may be readily placed in any position from full on to completely off. (2) the orifice may be screwed into varying positions thus altering the rate of gas flow, or (3) the air shutter, which is a slotted metal disc, may be turned to admit varying amounts of primary air. The primary air shutter is fitted with a set screw to secure the shutter after adjustment has been made.

The air and gas mixture in the hollow burner head progresses through the arms to the individual ports. Here as the air-gas mixture passes out into the surrounding atmosphere ignition occurs and goes on to completion combustion in the presence of secondary air.

1. An iron casting so designed as to provide
   (a) Mixture head with hair shutter to permit the sucking in, or entrainment, of air for mixture with the gas supplied prior to ignition.
   (b) Mixing tube to conduct the air-gas mixture forward to
   (c) Burner head with 8 arms to spread out the gases for release through vertically drilled holes called ports.
2. A burner cock controlling the admission of gas from the gas pipe or range manifold.
3. An orifice projecting the gas in a rapidly moving stream into the throat of the mixing tube in such a manner that suction so brought about pulls in air through the mixing head and air shutter in an amount proportional to that of the gas admitted by the orifice.

Due to essentially all gas ranges in 1930 and before having the star type of burner, the majority of gas ranges in service today are so equipped. Since 1930 most manufacturers have adopted some modification of the star type, notably the round type which is described in detail in the next article. Irrespective of the type, all top burners involve basically the same elemental physical principles worthy of minute study.

With any given burner, one does not have to be a *mechanical Houdini* to perceive that the conditions having to do with the gas orifice and the air shutter are the prime factors governing the results achieved. Treatment of the gas orifice is naturally the first to be taken up. Initial concern is with the amount of gas introduced into the burner in a given time interval, such as an hour. Properly speaking, the orifice is that part of the burner assembly that controls and governs the rate of the flow of gas.

A little reflection on the problems incident to the orifice will establish that the following obvious, but variable, conditions will affect the rate of the gas flow.

(1) Pressure, expressed in inches of water column.
(2) Specific gravity, i.e., weight of the gas per cubic foot relative to that of air.
(3) Area of the orifice opening.

A more ready conception of the orifice can be had by imagining the same with a liquid, which resembles gas quite closely, flowing through the opening. One readily realizes that the greater the pressure, the more will be the gas going through such a hole. By the same token, the lighter the gas in weight (the less specific gravity) the easier the escape and hence the greater the flow. And, of course, the larger the area, the greater will be the quantity of gas in the jet, or stream. The problem is, exactly how and to what extent do these three factors of pressure, gravity and area control the gas delivered to the burner by an orifice.

After numerous series of competent tests, there seems to be general agreement that the awe-inspiring mathematical formula[2] appearing in the footnote below applies with a reasonable degree of accuracy to the most often encountered gas orifice. The attention of only the inquisitive and the brave is directed thereto. However, there are comparatively easy approaches that can be made to the orifice formula. In practice, the pressure is the factor most likely to fluctuate. The idea seems to be generally prevalent that the gas delivered varies directly as the pressure (for instance, that an orifice having 4″ gas pressure would discharge only half as much as when subject to an 8″ pressure) but such is NOT the case, because the gas quantity actually varies according to the relationship, obscure to some people perhaps, of the square root of the pressure. This square root business is not as bad as it sounds and to simplify matters, a brief tabulation is presented.

Square Roots of Common Manifold Pressures

12″	3.464	9″	3.000	6″	2.449	3″	1.732
11″	3.317	8″	2.828	5″	2.236	2″	1.414
10″	3.162	7″	2.646	4″	2.000	1″	1.000

[2]

$$Q = 1300\,A\sqrt{\frac{H}{S}}$$

in which Q = *quantity of gas discharged, cu. ft. per hr.*
A = *area of orifice, sq. in.*
H = *gas pressure, in* H_2O *column*
S = *specific gravity of gas (air = 1.0)*

That is enough to floor the less sophisticated, but let us puzzle out what it means. Suppose for the sake of illustration a concrete example is taken in which the orifice (A) is 0.00385 sq. in. or a No. 50 Standard Twist Drill, the gas pressure (H) is 9″ and the specific gravity (S) is 0.40, then substituting in the above equation:

$$\text{Quantity discharged} = 1300 \times 0.00385\sqrt{\frac{9}{.4}}$$
$$= 5.005 \sqrt{22.5}$$
$$= 23.7 \text{ cu. ft. of gas per hr.}$$

[1] *Particular reference at this point involving technique of burner design is made to "The Service and Practice of Gas Supply," Volume II, by Arthur Coe, published by Stott Brothers, Ltd., Lister Lane, Halifax, which contains a most lucid presentation of the complete subject. Mention should likewise be made of such American sources as "Combustion" by the American Gas Association, "The Aeration of Gas Burners" by Kowalke and Ceaglske in A. G. A. Proceedings—1929, "Fuels and Their Combustion" by Haslam and Russell, published by McGraw-Hill Co., Bur. Standards Tech. Paper 193 and Circular 394, and "Gas Engineering Handbook," published by McGraw-Hill Co. The foregoing references are of such a technical nature as to interest only those concerned with the finer considerations of design or distribution problems of a most unusual nature.*

Of particular interest is that the quantity (Q) varies as the square root of the pressure (H). Thus, if as in the foregoing, the quantity is 23.7 cu. ft. with a 9" pressure, a reduction of the pressure to 6" would diminish the quantity to 19.4, or reduced to 4" pressure, (Q) would equal 15.9. The quantity (Q) also varies inversely as the square root of specific gravity (S) and directly as the area (A).

This simple disposition of the orifice formula will doubtless outrage the sensibilities of the more serious student of gas engineering. The truth is that numerous other factors influence this abbreviated formula. The constant of 1300 here used reflects a disregard for what in many instances are important considerations. Among the prominent factors is the angle at which gas approaches the orifice opening. A second factor is whether the opening constitutes a sharp-edged orifice or a channel effect. In the case of a channel, the distance or length of such in relation to the area of the opening has an important bearing on (Q). Study may be pursued in "Efflux of Gas Through Small Orifices," U. S. Bur. of Stand. Sci. Paper 359, and in "Flow of Gas Through Orifices on Domestic Appliances," Am. Gas Assoc. Lab. Bulletin No. 1, and in A. G. A.'s "Mixed Gas Research."

With this data anyone capable of arithmetic can calculate the effects of pressures on the gas input to a burner. Presume for a moment that at 6" pressure a burner was rated at 21.0 cu. ft. per hr. and the pressure was reduced to 4" (a loss of 2" or a 1/3 drop) the quantity then becomes

$$21.0 \times \frac{2.000}{2.449} = 17.2 \text{ cu. ft. per hr. in which}$$

from the table the values for 6" and 4" were taken. The quantity then was reduced but 18%. By the same method, increasing a 3" pressure to 5" increases the quantity not 66-2/3% but only 29%. This fundamental natural law is a real "break" for gas properties cursed with fluctuating line pressures (plus or minus 25% pressure having no perceptibly adverse consequences).

In the final analysis, the real purpose of the orifice is to introduce B.t.u. into the burner at the proper hourly rate. To accomplish this fundamental objective necessitates taking into account the thermal value, or B.t.u. content, of the gas. Thus, since most domestic top burners are rated at a 9,000 B.t.u. imput per hr., the quantity of 525 B.t.u. gas required to deliver this prescribed number of heat units would be 17.1 cu. ft., whereas for 1,050 B.t.u. gas, the amount would be half as much, or 8.6 cu. ft. of gas to effect the same B.t.u. input. Generally speaking, as the heat content increases, so does the specific gravity, although there are outstanding exceptions (such as a 525 coal gas might have a gravity of 0.42 and a carbureted water gas of the same B.t.u. value might record a gravity of 0.70.) Further than this, alterations in the specific gravity affect the quantity of gas admitted to a given burner, but this phase is doubtless best left to the astuteness of distribution engineers. These circumstances illustrate why the necessity exists for employing care in selecting the orifice for each type of burner for a particular gas in a given locality.

A glimpse of the details of a common type of orifice is shown in the accompanying drawing, illustrating in addition to this, a standard burner cock of the angle type. Study of this orifice will assist in visualizing the application of the principles expressed in the foregoing general formula[8]. Appreciation can be readily gained of why the orifice must be free of burrs, or any other obstructions preventing a smooth, free-flowing gas jet emanating from the orifice. The orifice depicted is of the type adjusted by altering the position of the hole with respect to the wedge point, turning to the left lessening the B.t.u. input and screwing to the right increasing the input. Take a pair of flat-nosed pincers in hand and try an adjustment on an actual burner. The fixed orifice, i.e., the non-adjustable type, is seldom used on domestic top burners because of the flexibility offered by the adjustable type in accommodating more or less permanent changes in district pressure regulators, or other basic conditions.

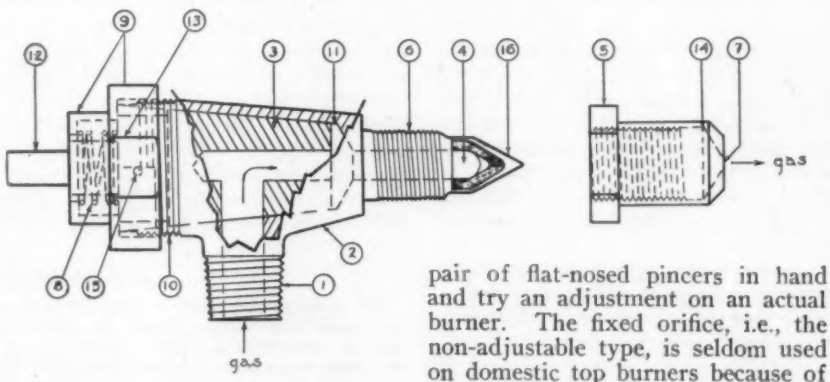
GAS COCK (Angle Type) and ORIFICE (Adjustable Cap Type)

The accompanying drawing illustrates a standard gas cock of the angle type (partially "cut away" to show plug (3) in cross-section) and its accessory, an orifice spud, or cap, of the adjustable type. The cap (5) screws on to the body of the cock at (6) thus allowing the wedge point (16) to approach the angle surface (14) and orifice (7). In accordance with the extent to which the cap (5) is screwed on to the barrel (6) means of adjustment is afforded.

Gas enters, as shown, into (1) which male screw threads into the main gas pipe, or manifold, on the range. The threaded end (1) is a part of the main cock body (2). Gas progresses through the bored cylinder (2) and hence through the hollow barrel (6) to the opening (4). Gas progresses around the tip of the pointer (16) and being confined by the surrounding cap (5) jets out through the orifice (7) as shown. The pointer (16) is ground down on two sides as shown by the shaded portion.

The tapered plug (3) is held tight against the sides of the body (2) by the coil spring (8) which spring is held by the top (9) that is threaded on to the cock body at (10). A small space is left at (11) to allow "take up" of the plug (3) to insure a tight seal against gas creeping back up between the plug and interior body wall.

The plug (3) may by means of a cock handle at (12) be revolved to turn the drilled vertical hole in the plug beyond the gas-way in (1) just shutting off the flow of gas. The plug (3) is, however, only permitted to move through a quarter turn (90°) by the pin (15) which is blocked by the slotted side wall of the cock. Gas may, of course, be only partially turned off, or "pinched down," by a shorter turn of (12).



The gas cock shown is remarkably free from service difficulties, particularly in those of more recent and refined manufacture. The same is likewise true of the elbow type of gas cock. Due to precision workmanship and sound materials, leaks are almost unknown, which are made even more remote by the ingenious spring keeping the plug pressing against the sloping barrel in the body. Even the once frequent complaint of sticking valves is rapidly becoming extinct, due to higher grade, temperature-resisting greases and in some instances to special graphite-impregnated plugs. If hard turning is experienced, the plug should be removed, both it and the inside barrel carefully wiped free of grit or caked grease, and the new cock grease applied sparingly only to the plug. Grease, although capable of withstanding up to 300°, is not a satisfactory remedy for a leak, nearly all such valves having to be replaced particularly if no "take-up space" remains. In the event the cock is removed, wiring or brushing of the gasways should always be carried out before putting back into service. A light coating of pipe dope is recommended for the threads on that part screwing into the manifold.

The next phase of the burner subject is concerned with primary air—how much, or how little? Before becoming entangled in a mire of "ununderstandables," let's refresh our minds on several points that many gas men seem to have varying con-

[8] *On pages 22 to 29, inclusive, of the second edition of the A. G. A. Range Manual, information is exhibited which should aid in the selection of the proper orifice under ordinary operating conditions. On page 922 of "Gas Engineering Handbook," an exceedingly handy alignment chart is published, designed for a similar purpose.*

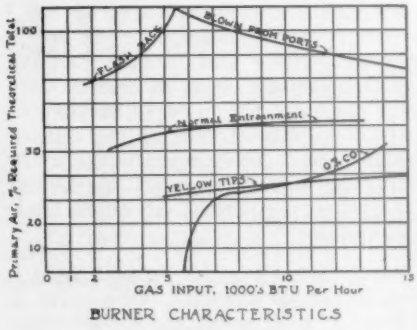
Most gas fitters carry a set of reamers for increasing orifice sizes. The indiscriminate use of this tool is frowned upon, although in skillful hands both time and money can be saved.

ceptions of. First, a definite amount of air is required to furnish a sufficiency of oxygen to complete combustion. Every individual gas requires an unchangeable quantity which is always the same for that particular gas. The fact that most manufactured gases necessitate about 4.5 cu. ft. of air for each cu. ft. of gas burned (natural gas about twice that amount) is rather common knowledge. A convenient rule-of-thumb is that 9 cu. ft. of air are required for each 1,000 B.t.u. of gas burned. Whatever this air requirement for combustion, it is possible to supply the same to the gas in either of two ways (or what is more probable, in a combination of two ways) that is, by so-called primary air, or by so-called secondary air, which terms doubtless need definition. Primary air is that which is introduced and mingled with the gas stream from the orifice before the mixture reaches the point at which ignition, or burning, occurs. In the domestic burner, the primary air is sucked in through the head by the momentum of the gas jet coming from the orifice (sometimes called "spud"). Secondary air is that which is furnished to the flame after burning has started. In the domestic burner, secondary air is supplied from the atmosphere immediately surrounding the ports and the flame itself. In normal domestic range operations, roughly 55% of the total oxygen comes from the primary air and the balance requisite to complete burning is supplied by the secondary air. After all of the air needed to carry out combustion completely has been mixed with the gas (which air we remember to be fixed in amount) any further secondary air, by being unable to enter into the chemical process of burning, is called "excess." Since such extra, or superfluous, air can only be introduced after burning has started, it is termed "excess secondary air." With a clear comprehension of these easy "grammar lessons" we advance to the next step.

To get the story across quickly, the accompanying graph is included here depicting "Burner Characteristics[4]." The intent is to graphically present the probable results to be anticipated by varying either the "Primary Air as % of Total Air Required" or the "Gas Input" on both of which factors burner performance depends. The top curves indicate the upper limits of primary air which, if exceeded, will cause the burner either to flash back or the flame to lift off of, or blow away from, the ports. Too much primary air creates a condition commonly referred to as *too lean* a mixture. The two lower curves, yellow tips and zero % of carbon monoxide, establish limits below which percentage of primary air combustion results can be expected that indicate *too rich* a mixture. The closeness of the "yellow tip" and the "0% CO" curves to each other leads to the conclusion that the presence of a sustained and definite yellow tip in the flame from an ordinary domestic top burner will, if fired under a utensil, be accompanied by a certain amount of carbon monoxide generation. It is significant that inadequate primary air occasions a lengthening of the flame. Therefore, the necessity of keeping the burner adjustment of primary air between the rather widely separated and lower limits is made immediately apparent by study of this chart.

The center curve, "normal entrainment," establishes, as the name implies, the per cent of primary air commonly employed under average operating conditions. Due to the air shutter setting being manually, considerable instruction and practice are required to properly train personnel to obtain the perfect flame insofar as primary air is concerned. The appearance of the flame itself is the only guide used in the field, which circumstance naturally involves the human element. Fortunately, the extent of possible choices is so wide that little serious difficulty is encountered. It is significant to observe in following the course of the normal entrainment curve that the per cent of primary air fluctuates only to a minor degree as the B.t.u. input varies, thus permitting the deduction that the primary air-gas mixture is not substantially altered until very low turn down positions of the burner cock are reached. This relationship emphasizes that the vertical side of the chart represents the primary air as a per cent of the total required air rather than as the amount of air in cu. ft. added to the gas before ignition. Thus, to further elaborate on the point, let us assume that 4.5 cu. ft. of total air is theoretically needed to complete the combustion of 1 cu. ft. of 525 B.t.u. gas, from which it follows that a 9,000 B.t.u. top burner on full would require $9{,}000 \times 4.5 \div 525 = 77.1$ cu. ft. of air per hr., but since approximately 60% of the total air (see chart) is mixed prior to leaving the ports, then $77.1 \times .60 = 46.3$ cu. ft. of primary air is introduced into the burner at 9,000 B.t.u. hourly input. At 4,500 B.t.u. input, or half the full burner rating, only about $46.3 \div 2 = 23.1$ cu. ft. of primary air is entrained. In either case, the balance

(Continued on page 47)



BURNER CHARACTERISTICS

Chart of Burner Characteristics

The accompanying chart is designed to depict the results to be expected with an ordinary top burner from various primary air shutter adjustments under varying conditions of Btu. input, i.e., Btu. input is plotted against primary air with the latter expressed as a per cent of that total theoretically required to complete combustion.

The area lying between the upper and lower curves (approximately from 90% down to 35%) represents conditions of burner adjustment under which flash back, flame blowing away from the ports, yellow tips or carbon monoxide will NOT be encountered. On the other hand, if the primary air is too great, either back firing or lifting flame will occur, depending upon the rate of Btu. input. If, however, too little primary air is admitted, the balance of the oxygen required for combustion must be supplied as secondary air, which by delaying the time of burning, lengthens the flame, bringing about thereby yellow tips and conditions conducive to the liberating of carbon monoxide.

At low rates of Btu. inpput (under 5,000 per hr.) it is virtually impossible to so adjust the primary air shutter as to produce carbon monoxide. However, at heat inputs of under 5,000 Btu. per hr. the primary air must exceed approximately 30% in order to avoid yellow flame tips.

[4] *In Bur. Stand. Tech. Paper No. 304, "A Method For Testing Gas Appliances to Determine Their Safety from Producing Carbon Monoxide," several charts are displayed indicating characteristics for various types of burners, the chart here included being redrawn with slight variations from data there shown for a giant burner having a probable rated input of 12,000 Btu. per hr. Present standard 9,000 Btu. top burners have substantially similar characteristics.*

[5] *From a design point of view there are several additional factors of importance bearing upon primary air entrainment, including the distance of the orifice from the throat and entrance to the mixing head, the diameter of the throat, the venturi shape of the head, throat and mixing tube, and also the temperature of the metal making up these parts. The rapidity with which the gas jet spreads out after leaving the orifice, as well as the coaxial relationship of the orifice and the throat together with that of the mixing tube, likewise condition primary air entrainment. Supplementing references in*

Pipe Corrosion and Coatings

By
Erick Larson
Gas Engineer

Part 2

Scope of Corrosion

THE scope of corrosion is vast and involves numerous natural and created factors together with various conceptions and theories of the reactions which occur. Corrosion is frequently termed deterioration, disintegration or natural devaluation or destruction of pipe materials. The broad scope of corrosion theories precludes any intensive presentation of the various schools of thought in a manual of practical mitigation. However, a knowledge of the various theories and factors contributing to the effects of corrosion are necessary to recognize the potential sources of corrosion when surveying areas surrounding existing or contemplated subsurface structures. The similarity of effects produced by several agents requires intimate study and careful analysis before the results may be attributed to a particular factor.

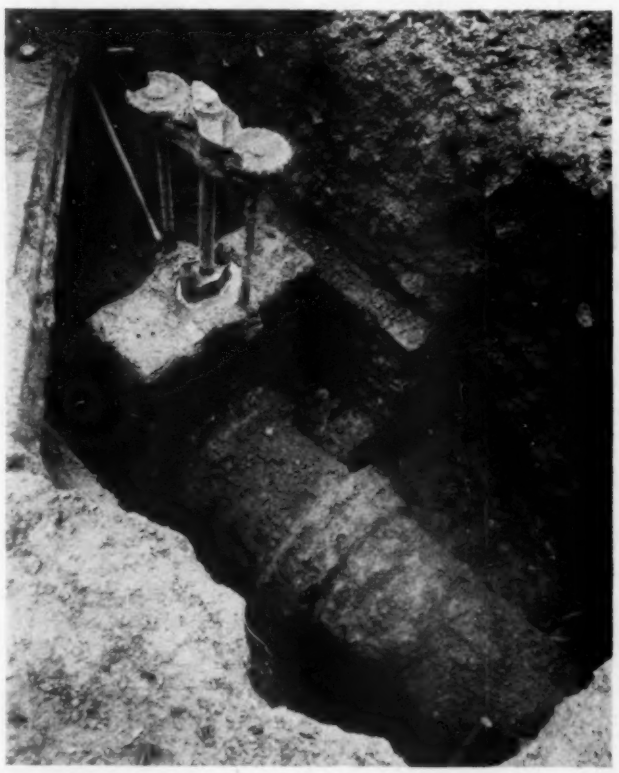
The general term corrosion includes in its scope the physical loss of weight or pipe material resulting from: uniform or non-uniform oxidation or rusting of the surface; pitting; erosion of pipe material due to wear from external physical forces; electrolysis; graphitization; solubility in liquids; combination with other elements or compounds or from any other medium or deteriorating agent. All materials used for the conveyance of gas, oil, water, steam, etc., are subject to corrosion under both favorable and unfavorable soil conditions, but the natural or controlled corrosion rate is the important factor. A slow rate of corrosion in many instances has resulted in a practically imperishable structure.

Physical deterioration may be averted, retarded or reversed depending upon economic considerations. Deterioration is averted by the use of pipe materials or protection known to provide permanency under the particular soil conditions encountered. Deterioration is retarded by providing a lower degree of protection than necessary for averting deterioration and by chemically or physically removing or decreasing the concentration or number of corroding agents. Deterioration is reversed when a pipe is restored to practically the equivalent of the original condition considering only the effects of deterioration.

The effects of corrosion, being physical, the resulting aging, wear and tear or deterioration is directly measurable. However, the rate of corrosion is not uniform and may cease completely. Therefore, the physical measurement of corrosion is seldom directly related to such values as pecuniary or functional depreciation which result from inadequacy, controlled or directed displacement or replacement, accidental or wanton destruction, obsolescence, abandonment for other causes than failure from corrosion, decrease of effective internal diameter, etc. The contrasts between corrosion and other types of losses are mentioned, as the tendency is to confuse the physical results of corrosion with depreciation, although there is practically no direct correlation.

Recognizing the sub-surface corrosion problem as arising from the physical change in pipe materials, interest is focused upon the causes. The forces producing corrosion may be generally classified as chemical, electrical or physical. The boundaries between these forces are frequently indefinite.

In the practical operation of sub-surface structures, the existence at any location of only one deteriorating medium is uncommon. However, the major proportion of deterioration may be frequently attributed to one factor. The corrosive agent present in the greatest quantity or concentration is not necessarily the one producing the majority of the corrosion. Corrosion is caused by the combined effect of the agents present, some of which may not directly act upon the metals but acquire corrosive properties by contact or reaction with other elements. Pure water only dissolves a small amount of any metal, whereas by dissolving and spreading a corrosive agent water may become the most vital factor and, therefore, the one to control. The difficulty in



20" Cast Iron Pipe—over 100 years old—uncovered in Chatham Square at Oliver St., New York City, for the purpose of removing an old double-gear gate to be replaced by a sleeve. Mr. Mauser, Asst. Engineer, reports that they have had no leaks in this line in a number of years.

recognizing the fundamental sources of corrosion has resulted in failure of many attempts to chemically treat soil to prevent deterioration.

The progressive rate of the action of any or all of the factors directly causing corrosion may be modified by time, temperature, pressure, saturation, concentration, comparative areas exposed, velocity of or relative motion between the solution and metal, surface film formations, etc., all of which will be discussed individually.

The complexity and broad scope of corrosion precludes the possibility of discussing all of the factors as a unit, but a knowledge of the effect of each is vital to properly establish the causes.

Chemical Theories

The oxidation or rusting of iron is one of the most frequently encountered corrosion phenomena. Ordinarily oxygen only unites directly with iron at extremely high temperatures and, therefore, a working theory is necessary to account for the occurrence of such phenomena at normal temperatures. A strictly chemical interpretation is that in the presence of air and water, generally containing dissolved carbon dioxide, carbonic acid is formed and attacks the iron, forming ferrous

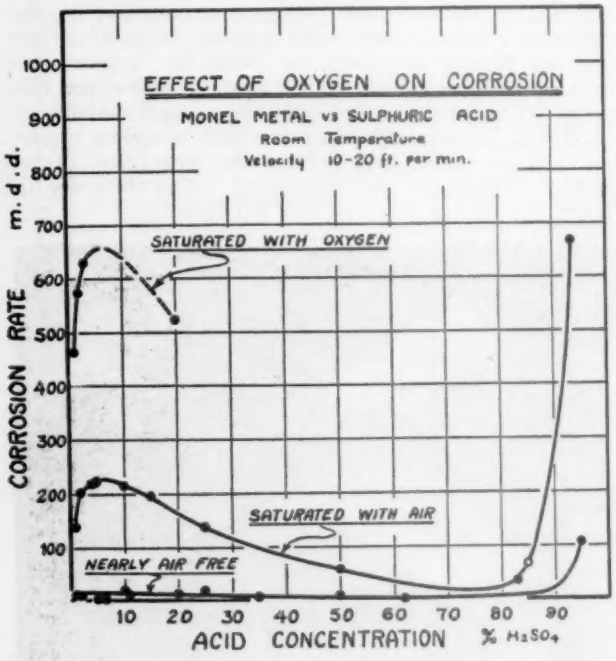


Chart from "Sulphuric Acid vs. Metals" by H. E. Searle and Robert Worthington of the International Nickel Company, Inc.

carbonate. The released hydrogen combines with oxygen from the air and decomposes the ferrous carbonate in the presence of oxygen and more water into ferrous hydroxide generating carbonic acid. The cycle is presumably continuous with the addition of small quantities of oxygen.

Another interpretation is known as the hydrogen-peroxide theory. Iron, oxygen and water interchange molecules to form ferric hydroxide and hydrogen peroxide. A continuous cycle results provided an adequate supply of oxygen exists.

These chemical theories have many weaknesses and are mentioned because of their historical significance and importance as steps in the development of the now generally accepted electro-chemical theory for explaining atomic separation and interchange.

Electro-Chemical Theory

The Electro-Chemical theory has more proof than any other conception concerning chemical reactions. Its extensive scope explains even the solubility of metals in pure water. Each metal has an individual tendency to enter into solution in water displacing hydrogen ions. The measure of this tendency is called its "Solution Potential."

Under proper conditions water may be changed in form and contain hydrogen and hydroxyl ions. An ion is an atom carrying an electrical charge. The positively charged hydrogen ion travels to the metal surface and loses its electrical charge to the metal atom, becoming a hydrogen atom and, forming a film on the metal surface, be evolved as a gas or both. The positively charged metal ion combines with the negatively charged hydroxyl ions forming ferrous hydroxide. If oxygen is present in the solution it will destroy the atomic hydrogen film on the metal surface by combining with the hydrogen to form water, completing a cycle and making the process continuous. A lack or deficiency of oxygen in the solution will gradually decrease and may in some cases prevent further solution of the metal as the hydrogen film on the metal surface would protect the metal. The tendency of the metal to go into solution is affected by the type of solution and concentration of metal ions in the solution.

The electrical force required to liberate the film of hydrogen ions as gaseous hydrogen is called the "Hydrogen Overvoltage."

The presence of minute particles of certain impurities or foreign matter having a different solution potential than iron, in or on the metal or the existence of acids in the solution will facilitate the equalization of electrical potential difference and increase the rate of iron entering solution.

In acid solutions having a pH (measure of hydrogen ion concentration) value of 4.5 or less the hydrogen ion concentration is sufficiently high to continuously cause the production of gaseous hydrogen and results in continuous corrosion of the metal. Conversely the presence of alkalies and some other substances in the solution de-

Electromotive Series Table *

ALKALI Cs, Rb, K, Na, Li	
ALKALINE EARTH Ba, Sr, Ca	
MAGNESIUM	
ALUMINUM	1.276
MANGANESE	1.075
ZINC	.770
CHROMIUM	
CADMIUM	.420
IRON	.340
COBALT	.232
NICKEL	.228
TIN	.192
LEAD	.148
HYDROGEN	.000
COPPER	.336
ARSENIC	
BISMUTH	
ANTIMONY	
MERCURY	.748
SILVER	.771
PALLADIUM	
PLATINUM	.863
GOLD	1.079

Any metal will replace any other metal below it in the series.

* *From "The Handbook of Chemistry and Physics, XVI Edition."*

creases the hydrogen ion concentration and diminishes or tends to prevent the iron entering solution by the formation of an impervious film of rust.

The solution potentials of metals may be arranged in a so-called "Electromotive Series" with hydrogen used as an arbitrary standard, the values determined for each metal being termed the "Normal Hydrogen Potential." If all other factors affecting corrosion could be held constant the normal hydrogen potential would be a measure of the corrodibility of a metal. The complexity of corrosion precludes any such simple criteria and values determined by various investigators do not only disagree occasionally but change the relative positions of the metals.

This electro-chemical corrosion of iron is a phenomena distinct from that produced by stray currents although the resulting appearance may be identical. A distinguishing characteristic between the two phenomena is that in stray current electrolysis, the distance traveled by the current is infinitely greater than in electro-chemical electrolysis where the potential difference is inherent in the elements involved and not imported from a source foreign to the area of corrosion.

Oxidation of Metals

Metals, particularly the ferrous metals, are frequently found in their native state as oxides indicating a high degree of affinity between the two.

Water tends to dissolve any metal immersed. A simple explanation of the oxidation of iron is that the iron having a stronger affinity for the oxygen molecules in the water than the hydrogen causes a breaking up of the water into two parts with the metal attaching itself to the hydroxide molecule.

Fe(iron) $+ 2H_2O$ (water) $= Fe(OH)_2$ (ferrous hydroxide) $+ H_2$ (hydrogen)

Ferrous hydroxide is an unstable compound when in the presence of oxygen and will change to reddish brown ferric hydroxide more commonly known as rust and chemically designated as $Fe(OH)_3$ or to the black ferrous oxide designated as FeO.

$2Fe(OH)_2 + 1/2\ O_2 + H_2O = 2Fe(OH)_3$ (ferric hydroxide)

$Fe(OH)_2 + H_2 + 1/2\ O_2 = FeO$ (ferrous oxide) $+ 2H_2O$

Red rust is formed by the additional oxidation indicated by:

$2Fe - 1/2\ O_2 = Fe_2O_3$ (ferric oxide)

The oxidation of a metal may also occur from reactions between the metal and acids during which reaction the rate of oxidation is much more rapid than the type previously explained. With acids other salts than the oxides may be formed and remain permanent or in turn be acted upon and changed in form.

It was mentioned that when a metal is immersed in water it tends to enter solution and cause a potential difference between the elements involved. One theory of the oxidation process is that the potential difference results from variations in the concentration of oxygen on the surface of the metal. This particular theory may be used to substantiate the greater frequency of intense localized oxidation occurring on sub-surface structures compared with bare metals exposed only to atmospheric conditions. However, this substantiation presupposes oxygen in a gaseous form as the sole oxidizing agent. Highly localized corrosion may also occur from the stronger affinity of some metals for the oxygen in a compound such as a nitrate than the remaining elements have the ability to resist, and transposition occurs.

The common pipe metals will not oxidize at normal temperatures in an atmosphere devoid of moisture. The quantity of moisture necessary is small and the air need not be completely saturated to facilitate the reaction.

Conversely, oxygen is necessary in moisture for any appreciable corrosion to occur and is essential for oxidation. The limit of corrosion in oxygen free water would be the maximum solubility of the metal in water which would be a small quantity. Corrosion will occur in the presence of water and oxygen without the assistance of acids or other agents. Oxidation will occur in pure water containing absorbed oxygen. Increasing the oxygen concentration in dilute acid solutions accelerates the corrosion of iron.

The various effects of oxygen concentration in acid solutions on the rate of corrosion is susceptible of laboratory proof. The laboratory determination of the effect of various agents in promoting corrosion is desirable to facilitate the more accurate prediction of the results to be expected in actual conditions. However, the numerical results secured in laboratory tests are but seldom directly applicable to actual conditions. The laboratory results obtained are more valuable for indicating comparative tendencies than producing directly applicable equations.

The difficulty of the laboratory prediction of practical corrosion lies in the indeterminability of the eventual cumulative result of the many factors causing corrosion. A high concentration of oxygen, ordinarily detrimental, has been known to decrease the average rate of deterioration by assisting in the formation of natural protective coatings.

Film Formations

The phenomena of natural films may occur on the surface of buried pipe in solid liquid or gaseous form. These films possess widely varying degrees of chemical activity with affinity for and thus solubility of the pipe metal, together with their properties of imperviousness, continuity, adherence, cohesion, physical characteristics and electrical conductivity, all or any of which may affect the corrosion inhibitive or accelerative value of the film.

Any type of natural film may completely isolate a metal from corrosive agents either temporarily or for an indefinite period. During the progress of film formation, corrosion of the metal may occur and the film produced may be the cumulative effect of several film properties rather than of any one. Films which may be composed of solid compounds of the pipe metal, frequently cover the entire surface of the metal. The rate of corrosion of the metal may gradually decrease and may eventually cease as the surface is more completely covered by the film. Continuity of protection by a film covering the entire surface depends upon the ability of the film to remain intact while subjected to chemical, electrical and physical surrounding forces. Movement of the pipe or surrounding earth may rupture the bond or adhesion between film and pipe metal producing an aperture into which moisture and gases may penetrate. The cohesion between film particles may be insufficient to withstand the action of physical forces resulting in a crack or flaw in the film. Differences in coefficients of expansion may rupture the bond between the film and the pipe. The film may form during dry periods and when subjected to submersion, failure of the film to separate pipe and corrosive agents may occur or the film may absorb moisture and thereby assist corrosion. The film may be attacked or dissolved by agents initially

absent. Stray current electrolysis occurring after establishment of film may destroy the protective ability of the films.

Any partial destruction of the corrosion protecting value of the solid films would ordinarily only cause localized contact between the corrosive agent and pipe. The small area of pipe metal exposed at the localized contact may cause a concentration of corrosion and result in rapid penetration of the pipe wall. The rate of localized penetration is frequently more rapid than with a uniform exposure of pipe metal to the corrosive agent. A natural film may therefore mitigate corrosion over the major portion of pipe surface but where the film was ruptured, more rapid penetration of the pipe wall would usually occur than if there had been no film formation.

Ordinarily, solid natural films do not entirely inhibit corrosion but through partial or total exclusion of many corrosive agents, and particularly water, the film slows the rate of progress of pipe deterioration and frequently alters the type of corrosion.

Texture of Exposed Surface

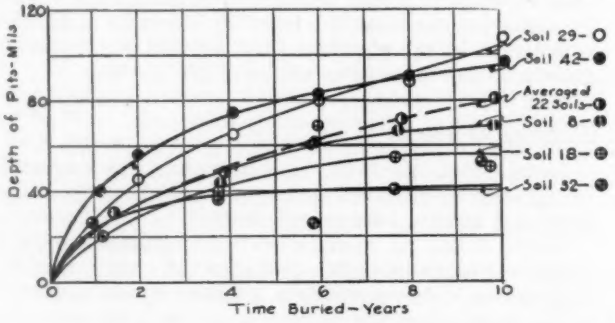
Metal surface conditions such as texture and homogenity are sometimes claimed to enhance the corrosion resisting properties of certain pipe but investigations have proved that external conditions have more significance. To a limited extent the claims are true as for instance, mill scale materially retards the average rate of corrosion but can not be depended upon to cover the entire surface of the pipe. Due to its disadvantages it is usually removed at the mill. Mill scale is electro-negative to pipe metal and therefore would increase the rate of pitting under proper circumstances. The relative area of exposed pipe scale to pipe metal on pipe from which scale has not been removed, is large and therefore pitting of the pipe by galvanic action will be rapid at the exposed area of pipe metal. Therefore, while mill scale is highly resistant to corrosion, its presence may result in more rapid failure from pitting than would occur in its absence. A considerable excess of molding sand on the surface of certain types of cast iron pipe has the property of retarding corrosion. These characteristics result from manufacturing processes in which the primary object is not to provide a surface resistant to corrosion, as this resistance occurs only incidently from the manufacturing process and is not of sufficient uniformity to be dependable. Such a surface condition sometimes results in the assumption that the material itself is not uniform, due to pitting occurring in highly localized and small areas, with the remaining sections unaffected.

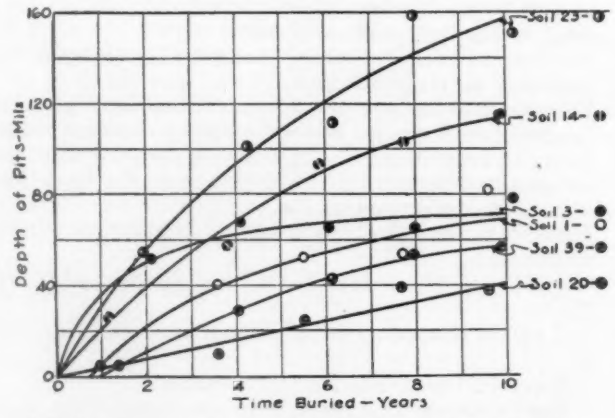
A rough surface, which may be produced by some seldom used rolling mill practices; moulding sands; sand blasting; etc., enhances corrosion by exposing more surface area and preventing an intimate contact between soil and pipe wall as can occur with a smooth surface. A rough surface facilitates galvanic action particularly in its initial stage.

Effect of Moisture

Selection of the term moisture as contrasted with water is for the purpose of emphasizing that moisture need not be present in sufficient quantities to be detectable by any of the human senses to abet corrosion. The dew point of the atmosphere may be lower than the temperature at any particular time but the corrosive agents may still be able to secure sufficient water to produce reactions. From this statement it follows that corrosion and particularly oxidation will occur to some extent in the atmosphere under all conditions naturally found in nature. Water vapor has the same effect in producing or assisting corrosion as water in the liquid state. A natural sequence is that for ultimate perfection in the mitigation of corrosion it is necessary to completely seal the metal not only from contact with water existing in its visible state but also from exposure to the atmosphere whether above or beneath the surface of the ground.

In arid climates oxidation is usually less uniform than in more moist regions as localized conditions provide greater opportunities for the collection of moisture. For instance in arid regions, corrosion has frequently been observed as more prevalent on the bottom of the pipe as a result of temperature differentials favoring the condensation or collection of moisture on that side.





*Physical measurement of corrosion indicates lack of uniformity.

Pipe may interfere with the capillary action which ordinarily results in loss of soil moisture through the ground surface or adhesion to the pipe may exceed the gravity which tends to pull the moisture into lower strata. Therefore, sufficient moisture may accumulate on or immediately adjacent to the pipe so that droplets will be visible. The location of the most severe corrosion may therefore frequently assist in determining the primary cause.

As the quantity of moisture available for wetting the pipe surface increases, corrosion problems usually increase. Tests conducted to determine the corrosiveness of soils show that the variations in rainfall not only from year to year but also from season to season are important, as the rate of corrosion may progress at a high intensity for only a few months and, therefore, predictions based on tests must consider the effect of variations. The most severe corrosion conditions have

(Continued on page 50)

**From U. S. Bureau of Standards "Soil Corrosion Studies, 1932," by K. H. Logan and R. H. Taylor.*

Volatile Therms in Coke

By Ivor J. Lane, M. Sc.

Poole, Dorset, England

TESTING work on a variety of coals, carried out on continuous vertical retorts at the works of the Bournemouth Gas and Water Company, England, has demonstrated the usefulness of the determination of the volatile therms in coke. Apart from its value in broadly indicating the quality of the coke, and showing the degree to which complete carbonization of the coal has been effected, the volatile therm content of coke, considered in relation to the amount of steaming, calorific value of the gas, throughput and retort temperatures, can assist one to come to a decision as to whether certain operations of the carbonizing plant are performing at maximum efficiency or not. A consideration of the thermal gas field alone can, at times, be very misleading, and might be responsible for wasted effort in seeking or applying remedies for deficiencies on the plant that do not exist. In consequence, there would seem to be some justification for the adoption of a volatile therm test for daily routine apart from its use in testing new coals.

To meet the needs of making an assessment of the volatile therms in coke which would allow, if necessary, carrying out daily tests, an attempt has been made to evolve an apparatus which would be simple to use, require the minimum amount of attention, and be reasonably accurate for routine purposes if not for research.

Description of the Apparatus

After much preliminary work, a form of apparatus shown herewith in Fig. 1 was decided upon.

The furnace, which is gas-fired, consists of a fireclay brick hollowed out into a circular hole throughout its entire length with the exception of 1 in. from the top of the brick. The hole is somewhat longer in diameter than that of the silica retort which it has to receive (see Fig. 1 for the actual dimensions). Near the top of the brick are side holes which allow the products of combustion to escape and enable the top of the retort to be kept cool.

The translucent silica retort is exactly 8 in. long, and has an internal base of 0.5 in., the thickness of its walls being ½ m.m. The side tube, of 2.5" length and 0.2" internal base, is sealed into the retort at a distance of exactly 1.6" from the open end of the retort to the bottom of the side tube. The open end of the retort is closed by means of a rubber stopper whose bottom side is protected with asbestos to prevent overheating of the stopper.

The above dimensions of the silica retort have been experimentally found to be the most suitable as they allow of sufficient coke (3.5 gms.) being heated at a practically uniform temperature throughout its mass

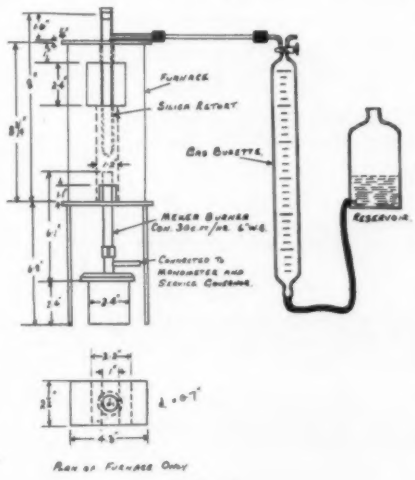


Fig. 1.

and, at the same time, allow of enough gas being collected for a complete analysis in a modified Orsat apparatus if a Bone and Wheeler apparatus is not available.

The gas is fed to the furnace through a Meker burner capable of passing 30 cu. ft. per hour. Variation of gas pressure is controlled by a service governor having a spring adjustment, the inlet pressure of the gas to the burner being indicated on a manometer.

Obviously, it will be necessary to standardize the position of the Meker burner, furnace, and silica retort relative to one another in order to obtain the desired temperature condition within the mass of coke, and which can be easily duplicated. In consequence, it is important that an assembly of the apparatus according to the specified dimensions given in Fig. 1 be strictly adhered to.

Using gas of 450 B.t.u., it has been found that a temperature of 1,100°c. can be obtained in 20 minutes, and kept thereat for four hours by controlling the gas rate so that a reading on the manometer equal to 6" is obtained. The air ports of the Meker burner were kept full open. For gas of a different calorific value, the most suitable gas rate would have to be experimentally determined.

The temperature of 1,100°C. is quite arbitrary, and is similar to that used by the South Metropolitan Gas Company, England, in their researches. The period of four hours appears to be the most appropriate, as the rate of gas evolution at the end of this time is very small.

The temperature in the silica retort is determined by means of Pt.-Pt. rh. thermocouple.

The gas evolved from the coke is collected in a gas burette of 500 c.c. capacity graduated to the nearest c.c. The confining liquid used is dilute sulphuric acid of 5% strength by weight.

Determination of Volatile Therms

The silica retort is charged with 3.5 gms. of air dried coke which has been previously ground to pass a 601. M.M. mesh sieve. The end of the retort is closed with a rubber stopper, the retort evacuated with the aid of a water pump, and filled with nitrogen freed from traces of oxygen.

The silica retort is immersed in the furnace so that the side tube of the retort rests on the fireclay brick. To enable the top of the silica retort to be kept cool during the heating operation a thin sheet of asbestos, 0.25 in. thick, with a hole punched in it of a size only sufficiently large to take the retort, is placed on top of the furnace as shown in Fig. 1.

After connecting the retort to the gas burette and seeing that the levels of the liquid in the burette and reservoir are exactly at 0 c.c. when the connections are open between the retort and gas burette, the gas burner is lit and the gas rate adjusted to the predetermined figure with the aid of the manometer and governor so as

Table 1

Table 1—*Particulars of Volatile Therms in Coke Analysis of Gas Throughput, Retort Temperatures, Proximate Analysis of Coke and Thermal Gas Yield on Carbonization.*

No. of Test	Analysis of Gas—Per cent					Calc. C.V. of Gas B.t.u.*	Vol. of Gas Cu. Ft. Per Ton N.T.P. Dry Basis A.F.D.B.	Volatile Therms A.F.D.B.	Prox. Analysis of Coke—Per cent				Coal Through Put Per Retort Tons Per 24 Hrs.	Retort Temperatures, °C.		Gas Therms on Carbonization Per Ton of Coal	Coal Carbonized D. Durham S. Scotch Y. Yorks.
	CO_2	C_nH_m	CO	H_2	CH_4	N_2								Top	Bottom		
									H_2O	Ash	Vol.	F.C.					
1	2.2	..	27.2	48.3	10.9	11.4	349	2134	7.5	0.98	11.32	0.95	86.75	5.88	1070	1320	73.2	50(D) 50(Y)
2	4.9	..	27.1	39.4	13.4	15.2	345	4031	13.9	1.01	11.00	3.41	84.58	5.93	1140	1370	80.1	Do.
3	3.1	..	31.9	48.3	4.0	12.7	295	4478	13.2	3.12	10.10	3.38	83.40	6.24	1130	1360	80.5	Do.
4	4.2	..	28.5	43.8	4.4	19.1	274	5156	14.1	1.23	15.61	2.91	80.25	6.12	1120	1360	79.8	Do.
5	2.6	..	32.7	38.2	12.9	13.6	354	2542	9.0	0.38	8.33	0.57	90.72	6.00	1100	1380	79.5	Do.
6	3.8	..	25.9	44.7	7.2	18.4	296	4264	12.6	0.89	11.33	2.59	85.19	5.76	1100	1350	74.5	Do.
7	3.7	..	37.7	41.6	9.4	7.6	346	3682	12.8	0.27	9.91	1.41	88.41	5.95	1100	1380	77.9	Do.
8	2.2	..	30.8	42.9	12.9	11.2	363	3292	11.9	0.79	11.42	1.92	85.87	5.71	1110	1350	80.0	Do.
9	1.5	..	28.6	35.6	19.1	15.2	395	3462	13.7	0.83	10.02	0.82	88.33	5.91	1110	1340	76.3	Do.
10	2.9	..	38.1	48.2	3.0	7.8	304	3466	10.5	2.80	9.93	2.04	85.23	6.11	1120	1360	79.9	Do.
11	3.2	..	33.2	45.1	2.0	16.5	269	3033	8.2	1.19	9.80	1.87	87.14	5.99	1110	1360	78.8	Do.
12	4.2	..	18.1	52.9	22.3	2.5	251	1579	4.0	0.31	8.29	1.81	89.59	5.53	1123	1380	76.0	50(S) 50(D)
13	3.6	..	28.9	57.4	5.2	4.9	323	2551	8.1	0.80	10.67	2.11	86.42	5.90	1100	1360	73.3	50(D) 50(Y)
14	1.8	..	28.2	53.1	14.5	2.4	403	1076	4.3	0.68	10.27	1.90	87.15	5.51	1103	1367	76.5	Do.
15	2.9	..	27.4	51.2	6.8	11.7	318	2856	9.1	0.50	10.84	1.74	86.92	6.22	1090	1350	72.3	100(D)
16	7.5	..	33.9	47.1	4.2	7.3	299	2250	6.7	0.80	10.25	1.26	87.69	6.33	1073	1294	68.3	Do.
17	4.5	..	35.1	50.4	2.5	7.5	297	4075	12.1	1.71	11.98	2.03	84.28	5.73	1140	1380	75.2	Do.
18	2.9	..	26.2	58.2	7.5	5.2	343	2703	9.3	0.68	9.58	0.68	89.06	5.67	1143	1375	78.2	Do.
19	2.9	..	28.7	57.7	4.4	6.3	319	2142	6.8	0.83	8.58	2.29	88.30	6.00	1125	1388	76.0	Do.

* Based on New Determinations by Rossini, Jour. U. S. Bureau of Standards, July, 1933.

to enable a temperature of 1,100°c. to be maintained during the heating period.

The heating operation lasts 4 hours and 20 mins. At the end of this time the gas is turned off, the silica tube is withdrawn from the furnace and allowed to cool down to air temperature. The liquid level in the gas burette and reservoir is adjusted and the volume of gas read off. By taking the air temperature and barometric pressure at the time of the experiment the volume of gas evolved can be calculated to a N.T.P. dry basis.

The gas is finally subjected to a complete analysis. The analysis is corrected for the volume of nitrogen in the free space in the retort and side connection. From the corrected gas analysis and the calorific value of the individual gas components, the calorific value of the gas evolved from the coke can be calculated. Multiplication of the calorific value of the gas by the volume of gas evolved in cu. ft. per ton of coke, divided by 100,000 gives the number of volatile therms evolved from the coke. This figure can be corrected to an ash free dry basis.

It has been found that results can be duplicated with ease to within 1%

Results of Tests

Data covering several tests on coke discharged from upwardly heated continuous vertical retorts are given in Table 1. Particulars are given of volatile therms, analysis of gas, throughput, retort temperatures, thermal gas yield from the coal on carbonization and volatile content of the coke as ordinarily determined by the crucible method at 965°c. In most instances the coal carbonized was a mixture of 50% Durham and 50% Yorks. In the other tests, 100% Durham coal was carbonized and in one instance 50% Durham and 50% Scotch.

The data show that the volatile therms, in coke produced under normal conditions, vary widely. It is to be expected that variable effects upon combustion will be the natural outcome of this state of affairs.

Hydrogen and carbon monoxide form the main constitutents of the gas evolved during a volatile therm test. Methane shows a wide variation, from 2% up to 22.3% of the total gas. There is also a large variation in the amount of nitrogen evolved.

There appears to be no simple relation between the volatile content of the cokes as determined by the crucible method and volatile therms.

In Table 2 the results of tests have been arranged according to similar throughputs and increasing temperature of the retorts.

In Table 3 the results have been arranged according to increasing throughputs and similar retort temperatures. In these tests there is no clear indication of a simple relation between throughput and volatile therms. There are instances where a lower volatile therm content in the coke is obtained despite higher throughputs and lower retort temperatures. Evidence has been obtained during tests on 100% Durham coal showing that a low volatile therm content of the coke can result when the retort temperatures are exceedingly low and the throughput considerably above the normal. Some coals possess a low order of thermal stability which allows of rapid carbonization. For the coal mentioned its low thermal stability has been demonstrated in connection with its use as a boiler fuel.

Data are given in Table 4 showing the volatile therms and ignition temperature for a number of coke samples. The ignition temperature was determined by the Leeds University method.

There is no simple relation between the two properties despite the fact that the bulk density of the coke was practically the same in all the tests.

The values of the ignition temperature are very interesting. They show considerable variation, while some of the cokes possess ignition temperatures as low as certain well-known low temperature cokes.

It appears from the results given in Table 1 that coke is not of necessity impoverished in volatile therms when high thermal gas yields are obtained during carbonization. In certain of the tests, some of the highest thermal gas yields have been obtained simultaneously with high volatile therms in the coke. It is thought that, among other factors, the greater readiness of certain cokes to react to steam might be responsible for the simultaneous production of high thermal gas yields with high volatile therms in coke. It is known that certain coals are most difficult to steam down to the desired calorific value of gas, when the full benefit of the water gas reaction in the retorts is not obtained. That cokes discharged from continuous vertical retorts appreciably vary in reactivity is demonstrated by the data given in Table 5, which show the results of tests on coke from upwardly heated continuous vertical retorts. Although the reactivity was determined towards carbon dioxide at 900°C., a certain parallelism between the reactivity towards carbon dioxide and steam has been demonstrated by Professor Cobb and his co-workers at Leeds University.

In conclusion, I would like to express my thanks to Mr. Philip G. G. Moore, M. Inst. C. E., engineer and general manager to the Bournemouth Gas and Water Company, for his kind permission to publish the above work.

Table 2—*Effect of Retort Temperature on Volatile Therms For Similar Throughputs.*

No. of Test	Throughput Tons Per Retort Per 24 Hrs.	Retort Temperature °C. Top	Bottom	Volatile Therms.
1	5.88	1070	1320	7.5
13	5.90	1100	1360	8.1
5	6.00	1100	1380	9.0
7	5.95	1100	1380	12.8
9	5.91	1110	1340	13.7
19	6.00	1125	1388	6.8
2	5.93	1140	1370	13.9

Table 3—*Effect of Throughput on Volatile Therms For Similar Retort Temperatures.*

No. of Test	Throughput Tons Per Retort Per 24 Hrs.	Retort Temperature °C. Top	Bottom	Volatile Therms.
1	5.88	1070	1320	7.5
15	6.22	1090	1350	9.1
16	6.33	1073	1294	6.7
14	5.51	1103	1367	4.3
8	5.71	1110	1350	11.9
6	5.76	1100	1350	12.6
13	5.90	1100	1360	8.1
9	5.91	1110	1340	13.7
7	5.95	1100	1380	12.8
11	5.99	1110	1360	8.2
5	6.00	1100	1380	9.0
12	5.53	1123	1380	4.0
19	6.00	1125	1388	6.8
10	6.11	1120	1360	10.5
4	6.12	1120	1350	14.1
18	5.67	1143	1375	9.3
17	5.73	1140	1380	12.1
2	5.93	1140	1370	13.9
3	6.24	1130	1360	13.2

Table 5—*Reactivity of Cokes From Upwardly Heated Continuous Vertical Retorts.*

No. of Test	Reactivity to CO_2 at 900°C. Mean Per Cent CO in Exit Gases	Key Cobb Scale	Ignition Temperature °C. 1st.	2nd.	Retort Temperatures °C. Top	Bottom
20	8.1	0.16	445	422	1030	1260
21	23.6	0.60	365	365	1070	1290
22	17.4	0.40	390	390	1090	1320
23	23.8	0.61	395	395	1120	1320
24	14.3	0.32	470	470	1100	1320

Table 4—*Ignition Temperature and Volatile Therms.*

No. of Test	Ignition Temperature °C. First	Volatile Therms
11	472	8.2
12	432	4.0
13	410	8.1
14	400	4.3
15	358	9.1
16	440	6.7
17	367	12.1
18	358	9.3
19	405	6.8

Employee Training

by

Maurice D. Read

Secy. Minneapolis Gas Light Co.

A great deal has been written, during the past few years, on employee training, but from an extensive survey of a large number of companies, it is evident that responsive action, especially on the part of smaller companies, has been sadly lacking. The reasons for this apparent indifference are, I believe, three-fold:

1. An utter lack of understanding by the management of the benefits to be derived from a course in employee education.
2. Reluctance on the part of the management to provide the necessary stimulus because of the effort required.
3. Lack of a program, or outline, which can be followed in organizing training groups. The latter is particularly true in the smaller companies.

The first is, by far, the most important. But why is the management of so many companies blind to the unlimited possibilities—the golden opportunities offered them to combat an ever-increasing competition through the inauguration of a program which is destined to return large dividends—a program the monetary cost of which is negligible, but one which requires an energetic investment of hard work, time, and effort? Mr. Brooks, President of The Mid-West Gas Association, in a talk before that Association in Minneapolis, attributed this apparent indifference by so many in the industry to an attitude of laissez faire, but, if ever such an attitude had a place in our industry—which I cannot admit—it is now outmoded. Today, nothing takes care of itself—not even the fruit which so widely advertises your glorious state.

To present a concrete illustration of the results possible of attainment under a planned program of employee training in a small property, let me cite the results obtained in a property of approximately 5,000 meters located in Southwestern Michigan.

In July, 1935, after a great deal of searching for a course applicable to our needs, we started a program in employee education. The course we were interested in was one which embraced not so much the technical training of employees in their own particular jobs as a general study of the ramifications of the business in its entirety. Through this course, we wanted to train every employee to a point where he would be convinced that the gas business is one of the best industries in the world and where he would be proud of being a member of such an industry. We wanted our employees to realize that we were selling service and that our job was not complete until every consumer was satisfied. We wanted them to be able to answer any questions put to them or to know how or where to get the information. We wanted them to know the problems of departments other than their own and, above all, to realize that it is doing the little extras which are not specifically required that makes any service outstanding in the minds of the consumers.

In inaugurating our program, we finally selected as the basis "The Employee - Customer Relation Course," edited by the American Gas Association. This course was supplemented with talks by department heads and appliance manufacturers' representatives and by debates. Our meetings were held weekly and were enthusiastically attended by every member in our organization, although attendance was not compulsory, and meetings were held at night on the employees' time.

It was only a short time until a spirit of enthusiastic cooperation was manifested, not only among the employees and their departments, but by the consumers as well, and results were immediate. Let me give you a few facts to prove the above statements.

This property was originally one of a group of fifteen companies and, over a period of several years, it never had won a range campaign within the group, although ratings were on a percentage of quota basis. In August and September, two months after we inaugurated our training course, a six-weeks' range campaign was started. We won the campaign by selling 131 ranges, equal to 2.6 per cent of our meters. During the year 1935, a total of 514 ranges were sold, or approximately 10.3 per cent of the meters outstanding at December 31st. Let's look at the picture in another way. During the first four months of 1935, when business as a whole was better in this particular community than in the first four months of 1936, this company sold 124 ranges while for the first four months of 1936 it sold 224 ranges, an increase over 1935 of 81 per cent. I admit that I do not think this increase was due entirely to the employee training course, for there are many other factors involved, but I do feel that a very large percentage can be attributed directly to the course through the increased knowledge of our appliances and their uses, as well as a realization of the importance of personal service in building up consumer good will, on the part of all employees.

If time were available, I could cite many examples of sales which were the result of some outstanding and unusual service on the part of fitters, meter readers, salesmen, collectors, and people behind the counter, all of which contributed in making possible the above results. Similar or superior results can be obtained by any company which is willing to make the necessary effort. The problem of the large company is necessarily much more complex, but it can be done as I will explain later.

The second cause—indifference or reluctance on the part of the management to provide stimulus because of the effort required—must be changed. The old adage, "The benefits derived are in direct proportion to the effort expended" is a fundamental principle in any course of employee training. You MUST have the whole-hearted and enthusiastic cooperation of the management. Dignified acquiescence is not sufficient. How can anyone expect the employee to respond by donating his time and effort to a program, designed primarily to promote the company's interest, if those in control are not willing to do likewise? This problem, while not insurmountable, is exceedingly difficult, especially in a large company, but it must be solved or any effort will be wasted.

How can this situation be corrected? How can we awaken executives out of their inertia? This I am unable to answer, but I do know that, unless those companies awake to the need of a directed personnel training, they eventually will be lost in a com-

petition which has but started.

In inaugurating a program of employee training, it is imperative that a careful outline be prepared. Such an outline need not differ greatly in the material to be covered as between the small and the large company, but it will differ considerably in its application. For the company with forty employees or less, discussion can be handled very easily in one group. If there are more than forty employees, it is suggested they be divided into groups of not more than twenty each, and even smaller groups are recommended. In the organization with which I am presently associated, we have 42 groups with from 15 to 17 members in each group and, because of the small size of the group, we enjoy a much more spirited discussion of the topics. Our program, like that of the smaller company to which I have referred, is built around the American Gas Association Course.

A supervisory committee, including all department managers, was formed to assist in the administration of the course. At the first meeting of that committee, it was decided that enrollment in the course should be voluntary for present employees, but compulsory for all new employees. A questionnaire first of all was sent to each employee on which he was asked to signify his acceptance or rejection of the course. Those wishing to take the course were given a choice of meeting nights and hour of meeting. When all questionnaires had been returned, each employee was assigned to a definite group and an individual record sheet of replies was set up. As far as possible, groups were formed from among employees of the same or closely related departments. The selection of group leaders presented a problem. Should they be department managers, supervisors, or employees of outstanding ability? We decided to draw our leaders from among the rank and file of employees as recommended by their department managers. Again, as far as possible, leaders were assigned to groups within their own departments. With the organization of groups and group leaders completed, department managers then were assigned as group supervisors, each manager being responsible for three groups, whose meetings he must attend at least once each month.

Under our program the department managers group meets weekly as a conference group and also in the capacity of a supervisory committee. Meeting periods are devoted to discussion of group problems and to the actual study and application of the course. The group leaders—forty in number—are divided into four study groups of ten members each for training purposes. These groups meet once every two weeks under the leadership of four department managers who follow an alternating schedule in conducting the meetings. The employee groups also meet once every two weeks.

Group meetings follow a definite schedule we prepare, which shows the following information: number, leader, supervisor, meeting night, hour, place and date of meeting of each employee group. Department managers meet weekly on Tuesday at four o'clock, while meetings of group leaders are held every other Monday at 5:30. Employee groups meet every other week at the same time and place as shown on the schedule. Regular attendance at the meetings is expected and absentees must be excused in advance except in the case of emergency.

Subject material for group discussion is prepared as far in advance of the meeting as possible. Each week at the department managers' meeting, various members are assigned to select questions for the next meeting. These questions are submitted later to the group leaders and finally to the employee groups. All questions and answers are presented in mimeograph form, the question sheets being distributed in advance of the meeting while the answers to the questions are distributed at a subsequent meeting. The practice of handing out questions on the lessons prior to the meeting tends to promote a much more spirited discussion since it guides the employee in his study of the subject matter. All question sheets are prepared after careful consideration of the point of discussion and topics brought out in the managers' meetings. Answers are prepared from answers given, not only in the managers' meetings, but in the group leaders' meetings as well. Group leaders receive the answer sheets one week in advance of employee meetings, which enables the leaders to prepare for their meetings and guides them in directing the discussion of the groups.

Grading of employees is based on individual recitation and discussion, written tests, and attendance. The grading of individual recitation is given by the leaders assisted by their supervisors. The final grade is based on 25 points for attendance, 50 points for recitation, and 25 points for written tests. The training division receives a group leader's report from them following each meeting and, through such reports, we are able to keep in close touch with individual and group progress.

Interest in our program is kept alive through the addition of material not included in the text. Many problem case studies are used, most of which are taken from the complaint files of the company, while others are submitted by the employees themselves. In order to present the work carried on by the various departments, each department manager has developed a corps of speakers who visit the various groups and present a detailed outline of the operations of their departments. Occasionally meetings are assigned to the Sales Department, at which meetings the various domestic appliances are fully discussed. Our program also includes occasional talks by manufacturers' representatives and, since the manufacturer benefits directly through increased sales made by well-informed gas company employees, he is more than willing to lend his cooperation and assistance. Another interesting feature of our program is the Monthly Bulletin. This Bulletin covers the activities of the company as a whole and sets forth all items of interest to the employees, including statistical information such as number of meters added, electric installations removed, and any other data which it is felt will be helpful in enabling our employees to sell our company and its product to the public.

The training division of our company consists of a Director, Assistant Director, Group Supervisors, Group Leaders, and Employee Groups. All of the details in connection with the course are supervised by the Assistant Director.

This plan, while far from perfect, is submitted in the hope that it may serve as an inspiration and a guide to other companies which may be contemplating a course in employee education.

Chapter—Unit Questions

1. What is the purpose of the dialogue in Chapter One?
2. Why is the public so unfair in its criticism of utility companies?
3. What are the essential things the customer desires and expects from the Gas Company for his money?
4. How can the act of satisfying human wants be used to advantage in building customer goodwill?
5. How can the company create more goodwill among our customers?

(Continued on page 35)

1936 SCHEDULE OF GROUP MEETINGS 1936														
NO.	GROUP LEADER	SUPERVISOR	GROUP	MEETINGS	HOUR	PLACE	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	NO.
1	H. C. Mills	Mr. Kus	Office & Sales	Monday	8:30	Bldg. Dept.(Ctr.)	11th-25th	8th-22nd	13th	17th	7th-21st	5th-19th	2nd-16th-30th	1
2	Leonard Milano	Mr. Thompson	" "	"	"	" " (L.Ft.)	" "	" "	"	"	" "	" "	" " "	2
3	H. G. Dreisbach	Mr. Conway	" "	"	"	Eng. "	" "	" "	"	"	" "	" "	" " "	3
4	Edward Bevans	Mr. Lucas	" "	"	"	Bldg. " (R.Ft.)	" "	" "	"	"	" "	" "	" " "	4
5	Wm. J. Risk	Mr. Smith	" "	"	"	" " (Rear)	" "	" "	"	"	" "	" "	" " "	5
6	R. L. Robertson	Mr. Boyer	" "	"	"	Directors Rm.	" "	" "	"	"	" "	" "	" " "	6
7	George Frost	Mr. Knight	" "	"	"	Contract Dept.	" "	" "	"	"	" "	" "	" " "	7
8	C. W. Thomson	Mr. Kus	" "	"	7:00	Bldg. Dept.(Ctr.)	" "	" "	"	"	" "	" "	" " "	8
9	E. W. Selman	Mr. Smith	" "	"	7:30	Eng. "	" "	" "	"	"	" "	" "	" " "	9
10	D. W. Gleason	Mr. Lucas	Meter Readers	"	7:00	Bldg. " (Ft.)	" "	" "	"	"	" "	" "	" " "	10
11	H. A. Schultz	Mr. Boyer	" "	"	8:00	" " (Rr.)	" "	" "	"	"	" "	" "	" " "	11
12	R. C. Haslett	Mr. Thompson	Office & Sales	Tuesday	8:30	" " (Ft.)	12th-26th	9th-23rd	14th	18th	8th-22nd	6th-20th	3rd-17th	12
13	S. D. Willey	Mr. Knight	" "	"	"	" " (Ctr.)	" "	" "	"	"	" "	" "	" "	13
14	H. D. Huntley	Mr. Smith	Sales	"	"	" " (Rr.)	" "	" "	"	"	" "	" "	" "	14
15	D. W. Petersen	Mr. Conway	Office	"	7:00	" "	" "	" "	"	"	" "	" "	" "	15
16	H. P. Sherer	Mr. Kus	Sales	"	"	Engineering Dept.	" "	" "	"	"	" "	" "	" "	16
17	H. W. Spain	Mr. Berguson	Office & Sales	Wednesday	8:30	Bldg. Dept.	13th-27th	10th-24th	15th	19th	9th-23rd	7th-21st	4th-18th	17
18	O. B. Eichhorn	Mr. Black	Meter Repair	Monday	"	Meter Shp.Office	11th-25th	8th-22nd	13th	17th	7th-21st	5th-19th	2nd-16th-30th	18
19	D. R. Bayers	Mr. Speer	Service	"	"	Serv. Lunch Rm.	" "	" "	"	"	" "	" "	" " "	19
20	Wm. W. Marshall	Mr. Alwin	" & Mtr.Rp	"	"	Garage Conv.Off.	" "	" "	"	"	" "	" "	" " "	20
21	W. C. Eck	Mr. White	" " " "	"	"	Storeroom	" "	" "	"	"	" "	" "	" " "	21
22	James A. Kelly	Mr. Boyer	" " " "	"	"	Garage Class Rm.	" "	" "	"	"	" "	" "	" " "	22
23	T. O. Noble	Mr. Black	" " " "	Tuesday	"	Serv.Lunch Rm.	12th-26th	9th-23rd	14th	18th	8th-22nd	6th-20th	3rd-17th	23
24	Herbert Anderson	Mr. Speer	" " " "	"	"	Meter Shop Off.	" "	" "	"	"	" "	" "	" "	24
25	E. W. Ormsby	Mr. Speer	" " " "	"	7:00	Serv.Lunch Rm.	" "	" "	"	"	" "	" "	" "	25
26	L. C. Lee	Mr. Swenson	" " " "	"	"	Meter Shop Off.	" "	" "	"	"	" "	" "	" "	26
27	M. J. Grosbusch	Mr. White	" " " "	Wednesday	8:30	Serv.Lunch Rm.	13th-27th	10th-24th	15th	19th	9th-23rd	7th-21st	4th-18th	27
28	D. H. Becker	Mr. Swenson	" " " "	Friday	"	" " "	15th-29th	12th-26th	17th	21st	11th-25th	9th-23rd	6th-20th	28
29	B. F. Swanson	Mr. Berguson	Street Dept.	Monday	7:00	" " "	11th-25th	8th-22nd	13th	17th	7th-21st	5th-19th	2nd-16th-30th	29
30	Al C. Everson	Mr. Berguson	" "	Wednesday	"	" " "	13th-27th	10th-24th	15th	19th	9th-23rd	7th-21st	4th-18th	30
31	John J. Daly	Mr. Alwin	Works	Monday	8:00	Works " "	11th-25th	8th-22nd	13th	17th	7th-21st	5th-19th	2nd-16th-30th	31
32	F. H. Knispel	Mr. Conway	"	"	7:30	Number Five Holder	" "	" "	"	"	" "	" "	" " "	32
33	George B. Johnson	Mr. Lucas	"	Tuesday	4:30	Works Lch. Rm.	12th-26th	9th-23rd	14th	18th	8th-22nd	6th-20th	3rd-17th	33
34	James E. Reed	Mr. Alwin	"	Wednesday	4:15	" " "	13th-27th	10th-24th	15th	19th	9th-23rd	7th-21st	4th-18th	34
35	Paul Covell	Mr. Eck	" (Rotating)	Monday	1:00	" " "	11th-25th	8th-22nd	13th	17th	7th-21st	5th-19th	2nd-16th-30th	35
36	M. K. Wrench	Mr. Eck	" "	"	7:00	" " "	" "	" "	"	"	" "	" "	" " "	36
37	N. O. Midtlien	Mr. Eck	" (Special)	Friday	4:30	" " "	15th-29th	12th-26th	17th	21st	11th-25th	9th-23rd	6th-20th	37

Address of D. H. Frazer, Jr. Retiring President, Michigan Gas Association

IT gives me great pleasure to open the forty-fourth annual meeting of the Michigan Gas Association. I think it might be well at the outset to review some of the history of this Association because if my information is correct, this is one of the oldest Associations in the industry. It was formed at Kalamazoo, Michigan, in 1893 and the fine work of the Association in the form of committee activities and papers presented at the annual meetings has contributed greatly to the development of the industry through the intervening years. The Association has had a long and honorable career and to my knowledge has never had any censure directed against it and I trust that it will continue to have a long life of usefulness to the industry and to the citizens of our State.

1934 and 1935 have witnessed a reverse of the downward trend in evidence prior to that time and I believe it is safe to say at the present time that the gas industry in Michigan and in the nation has resumed its upward trend. The number of customers served at the present time is higher than at any time since 1930. Sales of gas during 1935 were substantially higher than in 1934 and sales for 1936 to date have shown an increase of about 7½% over 1935. The appliance business has again become an item of major importance. Sales of gas ranges during 1935 approximated 1,100,000, an increase of 30% over 1934. This is, of course, a substantial gain and a substantial number of ranges, but to my mind it is not sufficient. When we realize that any range over five years of age is out-of-date we must see that one of our primary problems is to supply our customers with up-to-date equipment. The manufacturers are now offering the finest appliances which the industry ever had to sell and we are failing in our duty to our customers if we do not make every effort to get these new appliances in their homes.

There has come a pronounced change in the gas business in Michigan, especially during the present year. This is the introduction of natural gas. We are all familiar with the first and rather disastrous experience at Muskegon but since that time Michigan natural gas has been discovered in such amounts as to make Michigan natural gas a factor of sizeable importance in the State. At the present time (June 25, 1936) there are 268 producing gas wells in the State of Michigan having an estimated open flow of 2,836,480,000 cubic feet per day. In addition there is now in the course of construction a pipeline which will bring Texas gas to the city of Detroit so that by the end of the year we may expect to see 70% of Michigan's 690,000 gas consumers served in whole or in part with natural gas. This change naturally gives rise to many new and different problems in distributing, servicing and selling. Househeating becomes available to those of moderate means and the advantages of mechanical refrigeration and automatic hot water heating becomes available to all.

The public utility industry as a whole has been the subject of many attacks during the past few years. I am happy to say that we have not been the subject of such vituperative attacks as some of our neighbors have. However, we have had many complaints and I think that some of us may have become a little discouraged about the public attitude toward us. These things are not new. They are the result of the national depression and the desire of a number of self-seekers to have something against which to raise their voices. I wish to repeat a quotation from Daniel Webster which was delivered over 100 years ago in the U. S. Senate and I think you will see that it applies equally well to those who are leading the attack against the utilities at the present time:

> "There are persons who constantly clamor. They complain of oppression, speculation, and the pernicious influence of accumulated wealth. They cry out loudly against all banks and corporations, and all the means by which small capitals become united, in order to produce important and beneficial results. They carry on a mad hostility against all established institutions. They would choke up the fountains of industry, and dry all its streams.
>
> "In a country of unbounded liberty, they clamor against oppression. In a country of perfect equality, they would move heaven and earth against privilege and monopoly. In a country where property is more equally divided than anywhere else, they rend the air with the shouting of agrarian doctrines.
>
> "What can such men want? What do they mean? They can want nothing but to enjoy the fruits of other men's labor. They can mean nothing but disturbance and disorder, the diffusion of corrupt principles, and the destruction of the moral sentiments and moral habits of society."

Ours is not an industry which need apologize for its existence. It has always rendered excellent service at a fair price. There are a number of facts with which we are all familiar but which bear repeating.

The gas industry is a large employer of labor. It has always paid fair wages to its labor. It was one of the first industries, when the depression hit us, to adopt the share-the-work movement instead of laying off help and decreasing wages. The utilities are good citizens of the communities they serve. They pay their taxes on time. There have been many struggling municipalities during the past few years who would have had to curtail or discontinue some of their essential services had it not been for the tax payments by the utilities. Such taxes have shown a constant and consistent rate of increase. The electric and gas utilities in Michigan during 1935 paid in direct and indirect taxes $12,628,-112.30 which amounted to 16¼% of gross revenues. We used to think that taxes of 10c per thousand cubic feet were high but in the face of this increase in taxes and increased labor costs, rates have been continually decreasing. In addition, the electric and gas utilities collected $2,330,-

107.41 in State Sales Taxes. In spite of the fact that the sales taxes are plainly labeled as such on the bills, our customers feel that when they pay the bill they are paying for utility service, consequently, this is indirectly a burden upon the industry. Adding this to the other taxes we find the total taxes amount to 18.7% of gross revenues. Adding the unemployment insurance tax and the sales tax on purchases, I believe it is safe to say that 20% of every dollar expended for utility service goes for taxes. This is an enormous burden and I believe that if our customers realized the amount of taxes they are paying when they buy utility service there might be more of a clamor for reduced taxation and less said about rates for utility service.

Mention of unemployment insurance brings to mind a problem which is shortly going to be before us and which should have the earnest consideration, not only of utility men, but of every business man in the State of Michigan. This is the old subject of the Social Security Law. The present Federal Social Security Law provides that employers will have a credit on their Federal tax of most of the tax paid to States which have Social Security Laws meeting Federal standards. This means that we will be regulated eventually by a State Law which has not as yet been passed. I am assuming, of course, that all States will pass such laws to get the benefit of the amount of the Federal tax which they may retain. A number of State Laws already adopted provide substantial credits to employers who stabilize their employment. The gas industry is of course such an industry. Our employment is as nearly uniform as it is possible for an ordinary industry to maintain. It is therefore to our interest and to the interest of the customers whom we serve to see that when Michigan adopts a Social Security Law, such a law will give proper recognition to the stabilization of employment in industries. This is only fair since an industry which does have stable employment should not be taxed to support another industry which has a highly erratic record of employment. There is not only the matter of stability of employment but there is also included in the Social Security Law the Old Age Pension problem. Many of us do not realize what the closing down of immigration has meant to this country. Practically all of our immigrants were young people. America at present is a country with a declining birth rate. This, coupled with the closing down of immigration, has increased substantially the average age of our citizenship and the average age is becoming higher every year. It is estimated that within a very short time 60,000,000 of our population will be over sixty years of age. M. B. Folsom, Treasurer of the Eastman Kodak Company and a recognized authority on social security plans, in concluding an illuminating address at the recent annual meeting of the U. S. Chamber of Commerce, said:

> "Employers must realize that the country is facing an old age and an unemployment problem, and that legislation to meet these problems is inevitable. The next election or the fate of this particular act in the courts will not solve them; they will be with us just the same. Business men should be tremendously concerned with these problems and should become better informed on the various factors involved. Those who have studied the problems thoroughly generally reach the conclusion that some form of governmental action is necessary. Merely to condemn efforts already taken is of no help."

I think therefore that we have an obligation not only to our employees but also to our customers and our stockholders to take an active interest in these problems and in the legislation affecting them so that our industry, which has always maintained stability of employment and recognized its obligations to its aged employees, shall not be unjustly taxed for the benefit of industries less enlightened in these humanitarian problems.

In closing let me repeat, this is a growing, vigorous industry still in its youth. I am proud of the industry and this Association. I am proud of the men in the industry. Let us leave this meeting with the knowledge of our obligations to our customers and employees, but with the further knowledge that we are entering a period of greater usefulness than ever before.

Gas Fellowship—University of Michigan

In the year 1900 the Michigan Gas Association established a Gas Fellowship at the University of Michigan, under the direction of Prof. A. H. White, then a young instructor in the Department of Chemical Engineering. This fellowship has continued for 36 years and is said to be the oldest industrial scholarship in the United States. During the entire course of its existence Prof. White, now head of the Chemical Engineering Department, has directed the work, which has contributed many young engineers to the gas industry. Outstanding among these is the first holder of the Fellowship, Herman Russell, now President of the Rochester Gas and Electric Corporation, Rochester, New York, and Vice President of the American Gas Association. Mr. Russell attended the annual meeting of the Michigan Gas Association at the Grand Hotel, Mackinac Island (July 6, 7 and 8), and is shown photographed with Prof. White and Fred Batten of Detroit, the most recent holder of the Fellowship.

Left to right: Prof. Alfred H. White, Fred Batten, Herman Russell.

W. H. Munro Elected President Canadian Gas Ass'n.

29th Annual Convention—Vancouver, B. C.

ONE of the best attended and most practical and interesting conventions ever held by the Canadian Gas Association was held at Vancouver, B. C., in conjunction with the Northwest Conference Pacific Coast Gas Association, July 8-10.

It was a meeting full of matters of vital importance to the gas industry throughout, and the hundreds of delegates, including many ladies, from down the Pacific Coast to Los Angeles and Southern California to as far east as Montreal and Quebec, Canada, went away with the feeling that it had been a wonderfully successful event.

The participation in the deliberations of the Convention by the Pacific Coast Gas Association added greatly to the success of the meeting.

Some exceptionally fine papers and addresses were presented to the sessions and President John Keillor's address was received with considerable interest. Mr. Keillor pointed out that the gas industry of Canada was not making the progress it should, as revealed by latest statistics, and expressed his opinion that the adoption of a therm standard for manufactured gas in Canada would be the first step towards recovery and in the best interests of both consumers and utility. He hoped the newly appointed executive would appoint a committee to go deeply into the study of gas standards in Canada and if possible, arrive at some satisfactory solution of the problems leading to the adoption of a therm standard throughout the Dominion.

W. H. Munro, General Manager, Ottawa Gas Company, Ottawa, Ontario, was elected President of the Association for the ensuing year.

Other officers elected are as follows:

1st Vice-President—E. J. Tucker, Toronto, Ont.

2nd Vice-President—T. P. Pinckard, Hamilton, Ont.

Secretary-Treasurer—George W. Allen, 183 Glengarry Ave., Toronto, Ont.

Members of the Executive Committee appointed include: J. M. H. Young, London, Ontario; Hugh McNair, Winnipeg, Manitoba; J. C. Dawson, Quebec City, Que.; V. S. McIntyre, Kitchener, Ont.; J. J. Humphreys, Montreal, Ont.; Julian Garrett, Edmonton, Alta.; J. B. McNary, Hamilton, Ont.; H. B. Fairweather, St. John, N. B.; D. G. Munroe, Montreal, Quebec; John Keillor, Vancouver, B. C.

It was decided to hold the 1937 convention in the city of Ottawa, Canada.

The Association's newly drafted constitution and by-laws were endorsed by the Convention and automatically became operative as from January 1, 1936. The constitution is very broad in scope and allows for the entry of natural gas companies into active membership on the same basis as manufactured gas companies.

The new constitution also places the Canadian Gas Association on a much improved financial footing that promises greater service to the industry generally.

A large proportion of the business sessions was given over to papers and deliberations on sales problems affecting the gas industry in Canada, the trend of thought being that something should be done to bring about larger sales of gas.

The entertaining features of the convention were all that could be desired, and throughout three busy days luncheons, drives, and boat trips including the ever popular annual dinner, were heartily enjoyed by all.

Many delegates took advantage of the cruise up Howe Sound, one of the most beautiful scenic trips on the American continent, and the Glee Club Band, made up of employees of the local gas and electric company, supplied music at several of the program features.

A visit was paid to the newly completed "All Gas Home," built by the B. C. Electric Co. Ltd., as a public demonstration of what gas can do towards bringing comfort and contentment to the home-loving public.

R. M. Conner, Director of the A.G.A. Testing Laboratory at Cleveland was the guest speaker at the local Kiwanis Club luncheon July 9th, and spoke on the subject of the Laboratory's work and the trend in gas appliance design, construction and performance. Mr. Conner also referred to the fact that the gas industry was not a monopoly.

Many prominent gas men from Canada and the United States spoke at the annual banquet.

It was truly a remarkably fine convention that will live long in the memories of the many delegates who were privileged to attend.

Some of the papers read at the meeting follow.

Safety First and Main and Service Hazards

By Jacob D. von Maur,

Dept. of Distribution, Consumers Gas Cimpany

Toronto, Ont.

IT should be axiomatic that the first consideration, in the laying or installing of mains and services, is the question of safety. Even though gas is acknowledged as the cheapest and most dependable of fuels, its continued use would be greatly handicapped if the customer were to get the impression that the distribution and utilization of gas were fraught with danger, or that gas was less safe than other fuels.

With the ever increasing congestion of a variety of underground structures and the increasingly heavy surface traffic together with other causes, unless proper care is exercised there is indeed the chance of an increased hazard. It behooves each company to consider carefully its proposed new construction work and its methods of maintenance and control so as to make sure that, neither by its own neglect nor by the acts of others, is anything done which will bring about a hazard. Gas, properly enclosed or conducted in gas-tight pipes and utilized in properly constructed appliances, is one of the safest and most economical of fuels, but gas escaping from its container may result in serious consequences.

The effect, upon the public mind, of a case of asphyxiation or an explosion is far reaching and the reaction on the business of the company is far greater than is, generally, appreciated. Note the psychological effect on the public of an aeroplane accident—especially if the plane happens to be one carrying passengers.

People, naturally, are shy of any service which they believe to be dangerous. Some years ago, in a certain city, there were many people who used gasoline as a fuel for cooking purposes. The commercial department of the gas company prepared a booklet showing the locations of the homes where the gasoline was so used. Whenever an accident occurred at any of these locations, the booklet was sent to those homes nearest the one where the accident took place and an "x" was placed opposite the location. The inference was "you next." It was interesting to note the results.

The public will not long be satisfied with the explanation that the accident was due to natural causes or to an "Act of God." It may ease our conscience to indict the Supreme Being for all our shortcomings but, until Gabriel sounds his trumpet and renders his judicial decision on that awful Judgment Day in the far distant future, I am afraid we will not be able to collect. In the meantime, our customers will probably form their own opinions and act accordingly.

Frost will come and frost will go and we must take cognizance of that fact when we install our various underground facilities. Iron will corrode and place a limit on the life of our main and service pipes; filled-in ground will settle, and banks of earth unless properly protected, will cave in; gas will burn when ignited, and under certain conditions will explode —sometimes with disastrous consequences; pipes and fittings, when under undue strain will break, and the weaker the pipe or connection the greater the chance of failure. Carelessness in doing work and failure to follow well known rules of safety, can lead to but one result.

The matter of conducting our work so as to bring about conditions which will result in the minimum amount of danger and the maximum amount of safety, is a question which should receive out utmost consideration and study. The problem, naturally, divides itself into three parts.

(1) Those hazards which are the result of the acts of others not directly connected with our industry.
(2) Those hazards which might have been prevented had the work been done in the present day most approved manner.
(3) Those hazards which are due to natural causes and which are beyond human control.

Discussing these three divisions in order:

First and foremost, is the practice of installing facilities of one utility without due consideration or regards for the rights of others. This practice has existed in the past and exists to a certain extent at the present time on the part of some utilities, both those operating as private corporations and those under the control of municipalities. No self-respecting utility engineer, for instance, would today permit a gas company to lay its mains through the walls of a sewer, water valve-chamber, catch-basin or manhole without first obtaining the necessary permission and authority for doing so, and yet in many cities there apparently has been a disposition to ignore the rights of the gas company and deliberately build underground facilities around the gas mains, thus bringing about dangerous hazards, both to life and property. Possibly this has been due to a lack of appreciation, on the part of others, of the danger of such practice, and perhaps the gas company failed to protest sufficiently.

A careful survey of the causes of broken mains, over a period of years, was made by one gas company, and disclosed the fact that over twenty per cent of all broken mains were due to foreign structures having been built around them. In addition to this number, thirteen per cent of the total number of breaks were directly or indirectly caused by the installation of foreign structures near the gas mains. We thus have thirty-three per cent of all breaks due to work done by outside agencies. Undoubtedly, many other breaks were due to similar causes but were reported as "cause unknown." These breaks are, potentially, the most dangerous, as the gas escaping readily finds its way into the manholes and conduits and is thus distributed over long distances.

In one city, a partial solution of the problem has been materially assisted by regular organized conferences with the engineers of the city and the various utilities operating underground structures. The closest cooperation and mutual helpfulness has been obtained and a realization of the danger of neglecting the mutual rights of each utility is now appreciated as never before. These conferences are unofficial and the guiding principle which actuates the group is one of equity and fair play, rather than frigid legality. When once the principle, that the responsibility for an accident lies with the utility whose work has brought about the condition which caused the accident, is thoroughly understood and appreciated the advantages of this mutual cooperation become apparent.

Secondly, the gas company has not always been entirely guiltless. Failure to realize faults in its own construction work, or to learn from experience so as to correct the mistakes of the past wherever possible, has resulted in accidents which probably might have been avoided.

A gas main rigidly supported at one point is always a source of danger. Sometimes a piece of solid rock is carelessly left in the bottom of the trench and the pipe, when laid, is allowed to rest thereon—thus making the rock act as a fulcrum. This constitutes an avoidable hazard and it should not be a matter of surprise if the pipe should break at some future date. Rigidly supported pipe on a single pier is bad practice, and the same results may be expected. The pipe should be supported on the pier by means of blocking.

Sometimes, trolley, electric or telephone poles have been placed close to the gas main and the concrete placed around the pole so as to also enclose a portion of the pipe; this is another example of bad practice, as the pipe is liable to break for the same reason. The swaying of the pole or movement due to frost may also cause the pipe to break. Excavations under service pipes may be the cause of bringing additional strain on the service fittings at the main, causing either the main or the service fittings to break. Naturally, the smaller cast iron mains are less able to withstand the various strains which modern conditions bring to bear on them. Fortunately, most companies have abandoned the practice of laying small cast iron mains. It is better to make the 6-inch cast iron main the minimum on congested streets and the 4-inch the minimum on residential streets, should it be advisable to use cast iron pipe. Steel pipe can be profitably utilized when soil conditions are good or if the pipe is properly protected with a corrosion-proof covering. But many 3-inch and 4-inch cast iron mains are already in existence, and special care must be used in making the service connections to such mains by adding reinforcements to the main at the point of connection. Wherever these small mains are tapped for any purpose whatsoever, the mains at the tap-hole should be reinforced.

All of these precautions are already well known and are in use where good distribution practice prevails. We all know that one of the most fundamental rules of pipe installation is to make sure that the

pipe is well supported throughout its entire length. The pipe is not, primarily, intended to act as a beam. The guiding principle of the entire installation is to avoid strains wherever it is practical to do so.

It is not the object of the writer to suggest what particular practices had best be adopted, but to point out that we are prone to blame conditions, over which we think we have no control, when frequently the fault is our own. "We have done those things which we ought not to have done and we have left undone those things which we ought to have done."

Thirdly, causes beyond our control. Under this heading we, frequently list mains broken due to frost conditions and pipes eaten out by corrosion or electrolysis. Are we so sure that these causes are beyond our control? It may be difficult to avoid breaks from these causes, but I would not like to admit in the light of present day knowledge, that it is entirely impossible. We can hardly take the stand that our service is the most dependable and the safest and, in the next breath, admit that we are at the mercy of the elements.

Corrosion can be very largely overcome by giving proper consideration to the soil and then applying the necessary protective covering which is best adapted to that particular soil. We know that frost may be expected in cold weather and, under certain winter conditions, may penetrate the ground until it reaches the gas and water mains, frequently causing breaks. Should we, therefore, when mains break throw up our hands and say that nothing can be done about it, that it is an "Act of God" and therefore we cannot prevent it? How long will the public retain its confidence in our service if, every time we have a cold spell, our service is rendered inadequate or even dangerous? Are we quite sure that the trouble is entirely due to the action of frost? True, we have more broken mains in winter than in summer, but we do have breaks during all the months of the year. For instance, the above mentioned survey by one company, disclosed the fact that fifty per cent of all the broken mains, during the period studied, took place during the months of January, February and March. Fifty per cent, therefore, took place during the other nine months of the year when frost conditions were not present; this is at the rate of 50/9 or 5.5 per cent per month. Now, if this 5.5 per cent were not the result of frost conditions, and assuming that the other causes obtain throughout the entire twelve months, we would have sixty-six per cent of all breaks due to causes other than frost. I appreciate, of course, that repeated frost conditions may have left strains, contributing to the breaks which take place during the non-winter months. It would seem, however, that two-thirds of all the breaks are due to factors which may be more or less controlled, but this control can only be obtained by the closest cooperation between all the agencies which have to do with the installation and maintenance of subsurface structures.

It should not be necessary for each utility to have an inspector to watch over the work of other utilities, in order to make sure that they do nothing to damage its particular structures. Undoubtedly, the management of most utilities would not countenance work, on the part of its employees, which would bring about hazards in the structures of other utilities. Every engineer, in charge of utility work, should impress upon his employees that it is little short of a crime to molest the underground structures of another utility. To do so is liable to cause property loss and to jeopardize life as well. When all engineers who have to do with municipal work thoroughly appreciate the responsibility which is theirs then, and not until then, will the maximum degree of safety be obtained. There is no group of professional men whose ethics stand higher than those of the engineer; but being human he is likely to give his attention entirely to the particular interest which he represents, and, frequently, overlooks the relation which may or should exist between this interest and the interests of others.

Our distribution work requires the most thorough knowledge of the action of physical and chemical forces. With a correct understanding of these forces, it is possible to design our work either to resist them or to avoid their effect to a very great extent. A service pipe connected at right-angles to a gas main will contract as the temperature falls, and the connections at either end must be made strong enough to resist this contraction, or opportunity must be provided for the expansion and contraction to take place safely. Unless provision for expansion is made when a railway track is laid, it will not stay in alignment. In the case of a street-car track, unless the track is securely held in place by the concrete pavement and the rails made of sufficient strength to absorb the increased stress due to temperature changes, the tracks will break or get out of alignment. This is a simple illustration of how natural forces have been overcome by the correct application of the principles of physics.

Recently, an article appeared in one of the trade journals suggesting that the work of maintaining the distribution systems in many cities had been badly handicapped during the past severe winter, owing to the fact that municipalities have, in some cases, been backward in clearing the streets of snow, and suggesting that gas companies take the matter up with the proper authorities, drawing attention to this condition. The suggestion was well intended but, I believe, many engineers would prefer the protection of a good covering of snow rather than to have the snow removed. To the fact that there was so very little snow in some cities, during the past winter, is attributed a greater number of main breaks than was the case in previous winters. In any event the question is more or less academic as, undoubtedly, the snow will be handled without reference to its effect upon underground structures. We must meet the facts as we find them.

Not infrequently, small leaks are considered as non-hazardous. In the writer's judgment every leak is a potential danger and the cause must be found and corrected regardless of expense. A leak, once reported, should have constant attention until it is found.

Recently, there has been developed an instrument, the Stethoscope, which is a new aid in finding leaks. Some companies report considerable success from its use. Certainly, every effort should be made to determine its value. With such an instrument, together with the judicious use of other leak-detectors now on the market, we are in a much better position than ever before to discover leaks promptly.

The general effect of frost conditions, and the best method of protection, I understand, is now being given careful consideration by the Distribution Committee of the American Gas Association. It is the duty of every gas company to assist the Committee by carefully studying and endeavoring to discover the cause of each leak that develops. We need the assistance of all who have to do with underground structures, and if this paper helps even to a very small extent, to bring about a closer cooperation between the engineers of the various utilities its purpose will have been fulfilled. The problem is one for engineers, not lawyers.

Mast Guided Holders—Old and New

F. C. Hill

Gas Engineer, and Paul Pierce, Asst. to Gas Engineer,
Hudson Valley Fuel Corporation, Troy, N. Y.

THE old adage "There is nothing new under the Sun" can be applied to a recent development in gas holder design. The center post tar seal holder, which has been evolved from the M.A.N. type holder, has its counterpart in the mast guided water seal containers of sixty or seventy years ago.

Last summer, the Hudson Valley Fuel Corporation, which is a part of the Niagara-Hudson system, had a 2,000,000 cubic foot center post holder built at its coke plant in Troy, N. Y. This holder is within six miles of one of the early center guided water seal holders located at Cohoes, N. Y., and the two of them afford an interesting contrast in methods of storing gas.

With the guiding done at the center of the holder no top rollers are

Cohoes Holder

necessary and in the case of the newly developed tar seal holder no rollers at all are required. The advantage of having no rollers apparently was recognized early, in the design of water seal holders. At one time there were about seventy of this type in existence throughout the world. They were not generally built, however, probably due to the fact that their size was limited by the length of wooden mast which could be secured.

The New York Power and Light Corporation used their 60,000 cubic foot capacity mast guided holder at Cohoes until seven years ago. The date of erection is rather obscure but as near as memory will serve it was built about 1870. In cleaning up some of the buildings adjacent to the holder papers were recently found describing the re-election campaign of Abraham Lincoln.

Paper read before the 29th Annual Convention, Canadian Gas Association and Northwest Conference, Pacific Coast Gas Association, Vancouver, B.C., July 8, 9, 10, 1936.

The new Troy holder is Bartlett-Hayward's latest design in tar seal holders and is the largest of the five center post type built so far, having a capacity of two million cubic feet.

It is very similar to the M.A.N. type holder with the piston floating on the gas inside a cylindrical steel shell. The gas is sealed off between the piston and shell with the usual cup mechanism of rubbing bar with levers pressing against shell steel. A double thickness of canvas connects the rubbing bar and the piston cup, thus providing a trough to hold the tar sealant at the piston level.

The characteristic feature of the holder is the center column which rises from the foundation to the roof and around which the piston is built. The Troy holder center post is made of three-quarter inch steel rolled to a diameter of five and a half feet. In its manufacture machined diaphragms were used, spaced approximately 5 feet apart, on which the plates were rolled and made fast. A circular gauge was used in taking measurements and it was found that over the entire length of the column the circumference varied from 17'—2¾" to 17'—3¼" giving a differential of ½" which showed a variation in diameter of approximately 3/16". Two sections each 92 feet in length were shipped to the job.

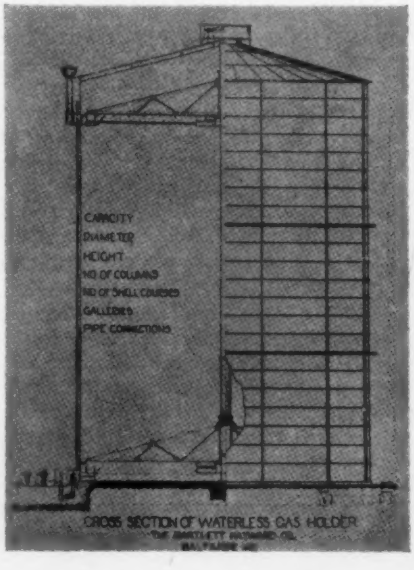
The two huge pieces were lined up across the concrete foundation of the holder and pinned together to be butt welded into one piece. The sections were accurately lined up with taut piano wires on the sides and the column rolled in order to check it for straightness on all sides. This work had to be done in the early morning for the midday heat of the summer sun would distort the shaft considerably. When the alignment was completely established the welding of the joint was done at night, and a final check made on the finished column.

The problem of raising the seventy ton column in one piece required considerable engineering skill. A temporary steel A frame was erected over the shaft. Two sets of blocks were hung from the top member of the frame. Cables were reaved through these blocks to two more blocks attached to a steel pin through the column at a point above the center of gravity and were brought down to two gasoline driven hoisting engines. The post was raised and the top guys set in four hours time.

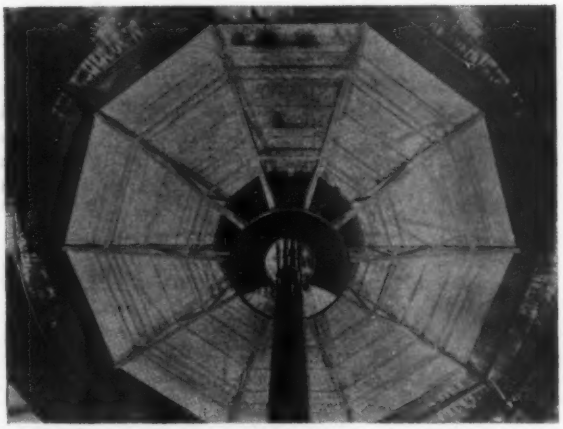
With the center post raised the bottom sheets of the holder were laid over a sand cushion saturated with gas oil as a preservative for the steel. The shell columns twenty in number were set radially from the post and the piston trusses erected within the circle of columns. As soon as the piston plating was welded to the trusses, work was started on raising shell sheets. The piston was used as a working scaffold carrying a trammel derrick for handling the material. A fan forced air beneath the piston, raising it as the work progressed.

When the shell had been built to its ultimate height, thirty inch roof girders were placed from each column to the center post. Beams were framed into these girders and sheet steel welded over them to form a conical roof over the whole structure.

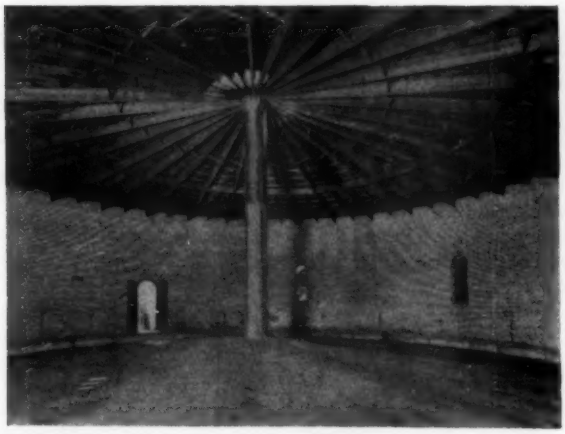
One of the unusual features of this holder is the fact that the shell sheets are curved. This forms a complete circle within which the piston works instead of the polygonal sides of the M.A.N. type holders. Because of this design the piston is free to pivot around the center column. However, there has not been as much as an inch rotation in the piston of the Troy holder since it was put in service the first of this year.



CROSS SECTION OF WATERLESS GAS HOLDER



Catch Basin on Piston of Baltimore Holder.



Interior of Cohoes Holder above Crown.

The diameter of the holder is 128 feet and its overall heighth 186 feet. The shell thickness is ¼ inch. The weight of the piston with tar in the cup is about 215 tons. When the holder is filled with coke oven gas of about .42 gravity the pressure exerted is 5.1 inches of water, when it is nearly empty or about two feet above landing the pressure exerted is 6.5 inches of water. This decrease in pressure as the holder fills is of course characteristic of all waterless holders whether of the center post type or not when containing gas of a gravity less than 1.0. It is due to the difference in weight between the column of gas inside the holder and a corresponding column of air outside.

The circulation of the tar sealant is somewhat similar to the method used on the M.A.N. type holders. Instead of the tar being discharged at the top of the inside of the shell, however, it is pumped directly to the top of the center post. Here it enters a distributor box which allows it to flow uniformly around the column and pour down the sides to a catch basin on the top of the piston. This catch basin encircles the center column and serves to provide a tar seal over the packing gland around the column, the sealant also provides lubrication for the ring of cast iron blocks which form the guides for the piston.

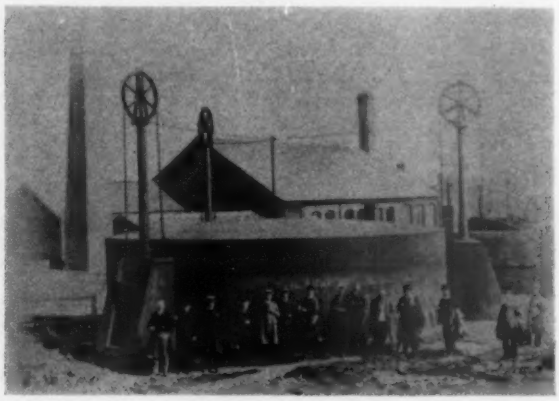
From the center basin a small quantity of the sealant flows downward through the stuffing box to a dam encircling the bottom of the column and this dam is connected to the outer tar dam common to the M.A.N. type of holder. Most of the sealant flows through two eight inch pipes which are hung beneath the piston plating. These pipes are diametrically opposite each other and carry the sealant to the outer cup providing the seal between the piston and shell.

Because of this system of central distribution no partitions are necessary in the cup. The tar flows uniformly around the cup and provides lubrication between the shell and rubbing bar. Also, since the tar when it is pumped back into the seal runs down the center column rather than down the sides of the holder it is protected from the extremely cold weather in winter and the hot weather in summer.

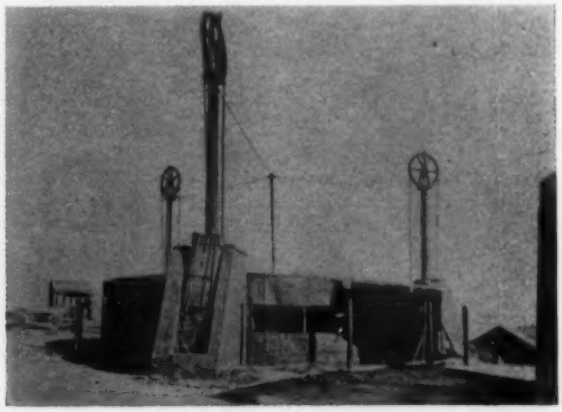
As the tar seeps past the piston it drops to a collection dam on the holder bottom and flows through weirs to one outside settlement tank instead of to several as in the case of the M.A.N. type. Tar heaters supplied with high pressure steam are used during the winter months to prevent the formation of ice in the collection dam and to cause the tar and water to flow freely to the outside settlement tank. Here the water condensed from the gas and carried out by the tar is allowed to separate. As it accumulates it can be skimmed off the surface of the tank just as is done with the M.A.N. holders.

For the two million center post holder, there are three motor driven pumps in a separate compartment of the tank, any one of which can be used to pump the tar up the riser pipe to the top of the center column. These pumps are actuated by a float switch so that as tar flows into the tank it is returned to the system after the water has been allowed to separate from it. The sealant is reconditioned in the same manner as is done with other tar sealed holders. During the winter months it has been found advisable to keep the water content of the tar in the cup below 3%.

The holder has proved to be very effective as a dehydrator during the colder months of the year having brought about a marked reduction



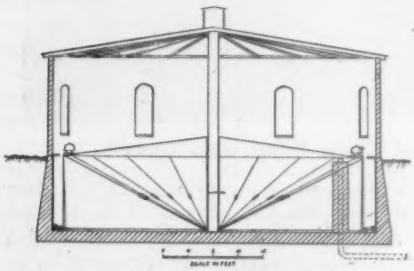
Soho Gas Holder about 1910. Courtesy, Mr. J. J. Humphreys.



Soho Holder, 1926. J. J. Humphreys.

in the amount of condensate taken from the transmission line drips. During the coldest weather the temperature of the gas entering the holder is about 50° F. and the temperature of that leaving 35° F.

The piston is guided along the center column by two rings of cast iron blocks spaced eighteen feet apart. They are incorporated into the ends of the top and the bottom chords of the trusses.



Cross Section of Cohoes Holder

The radius of these guide block rings is ⅛ inch larger than the radius or the column. The piston, braced in this manner, cannot go out of level beyond the limit of clearance of the guide blocks plus any deflection in the center column.

It can readily be seen that the best operating results on the center post holder will depend upon the accuracy of fabricating and erecting the center column. The nearer this approaches a perfect cylinder throughout its length the better will be the guiding of the piston and the packing will fit closer and more uniformly, resulting in the minimum of tar leakage at the center.

The fabrication and erection of the shell sheets in as nearly a perfect circle as field construction will permit is also important. The cup mechanism with its flexible rubbing bar and constant pressure against the shell will overcome wide variations in alignment of the steel. To prevent excessive irregularities in the shell wall a close control is necessary over distortion due to the heats of welding.

In the days when mast guided water seal holders were built the margin of accuracy was more liberal. Not having the advantages of present day methods of shop fabrication and modern erection equipment, greater tolerances were accepted in the field.

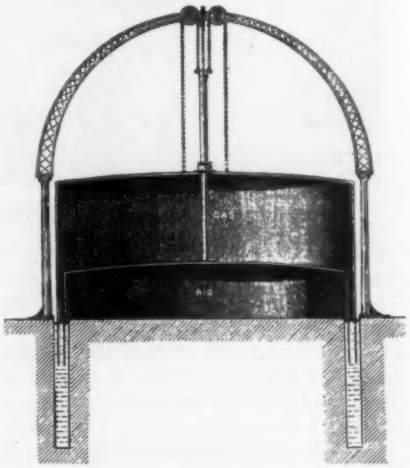
On the Cohoes holder an inch clearance was allowed between the lift crown and the center guide. The mast of white pine two feet in diameter and forty feet long was probably cut down in the woods along with others destined for sailing ships. It was carefully trimmed by hand as nearly round and smooth as possible. To insure a smooth surface on which the lift could ride, four pieces of flat iron 2½ inches by ½ inch were screwed into the mast on opposite sides.

The holder is enclosed in a brick building with a completely excavated brick pit fifteen feet deep. It is located on a high rocky ledge beside the Mohawk River and was used to serve the Harmony Knitting Mills with gas for their lights.

It has a single lift sixty feet in diameter with a circular well in the middle of the crown surrounding the wooden mast. The bottom of this pipe-shaped well is held in position by about twenty rods equally spaced around the bottom ring and attached to the curb angle of the crown.

There were no top guide rollers on the crown, the mast alone controlling the position of the top of the holder. Eight pit guides and rollers were used to keep the bottom of the lift in position. One of the guide rails was made with flanged sides to keep the lift from rotating. The other seven were made of flat iron. There is no permanent frame inside the tank, but the center well supports the middle of the crown and even with the holder landed out of service there are very few bad buckles in the crown plating.

When the holder was used five ornamental cast iron shapes in the form of huge acorns weighing about three hundred pounds each were placed around the edge of the crown to balance the lift.



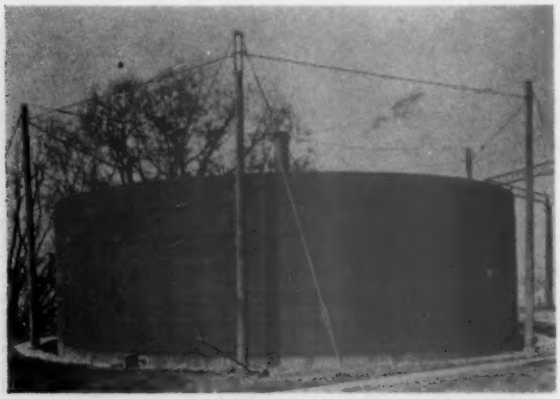
Stratton's Double Holder. J.J.H.

The top of the wooden mast supported the roof rafters of the building just as the steel shaft in the modern holders does today.

Vast strides have been made since the days of that old center post holder and yet the guiding principles are very similar in this recent development in gas holder design. New materials and methods of construction have made possible the construction of larger storage space but they are dependent on the same principles which inspired the mast guided water seal holder.

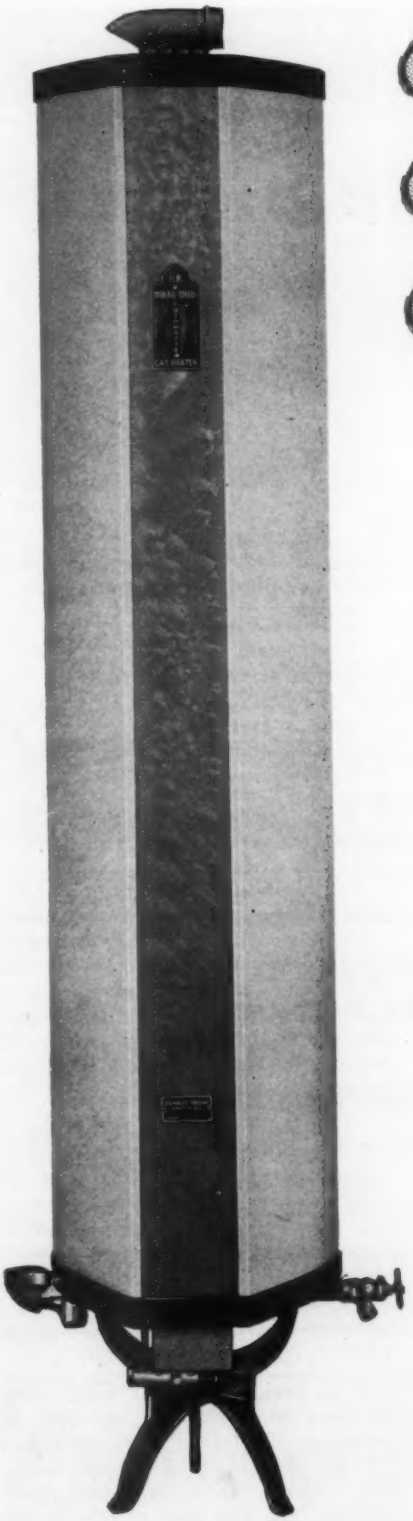
We are indebted to Mr. J. J. Humphreys of the Montreal Light, Heat and Power Consolidated for the following information on some of the

(Continued on page 46)



Mast Guided Holder, Frankford Works, Philadelphia.
Courtesy United Engineers and Constructors, Inc.

Hudson Valley Fuel Corporation Holder B. H. Co.



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NOTE *thousands in use!*

NOTE *in over 100 cities!*

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Developers and pioneers of the Low-input Gas Water Heater

Utility Encloses Non-Propaganda Magazine With Statements as Good Will Maintainer

By Willard E. Simms

IN July, 120,000 customers of the Public Service Company of Colorado were definitely reached with automatic gas water advertising at a cost less than one cent per contact.

The medium was a small non-propaganda booklet enclosed with each mailed statement, delivered with each statement in town. Carrying capacity of the men distributing statements in Denver was slightly reduced, but on mailed statements, there was no increase in cost at all, as postage was not affected.

According to Charles B. Roth, who edits the magazine, the circulation of this little magazine exceeds the circulation of any publication in Colorado, with the exception of one Sunday magazine. Such a circulation at less than one cent a copy is cheap for the goodwill created by the Public Service, indirectly reflected in its sales of gas, and gas appliances.

To produce results, however, this sort of publication must be *right*—it must be a true goodwill builder.

The magazine has to be one that is not crammed with propaganda—advertising about the firm sponsoring the publication. Many utilities issue magazines, but the Public Service edition is the first of its kind in being an actual magazine rather than an advertising sheet, Mr. Roth believes.

Advertising in this 16-page enameled stock booklet is limited to two pages at the back, and both of these are in the form of advertising, just as full-page ads in any magazine. One of them is educational advertising in showing how the gas or electric meters of the Public Service are checked both in the laboratory before they are installed, and then again during the life of the meter.

The other page is really commercial advertising, emphasizing the Public Service modern automatic gas water heater, and urging customers to turn in their old water heaters and have the new one operating within 24 hours by paying only $1.60 a month.

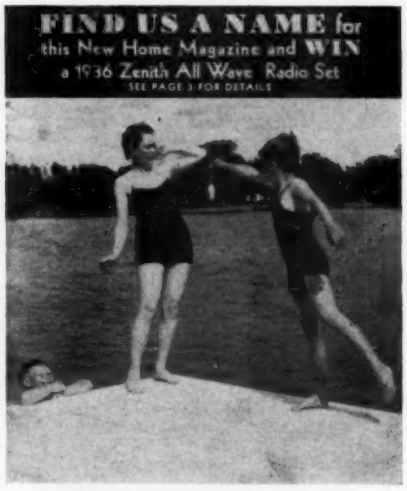
The magazine is unnamed, but the utility held a contest during July to get the best title for "This New Home Magazine." And this was another goodwill builder and indirect advertisement of the company.

A 1936 Zenith all wave radio set was the prize offered, and the contest was open to any customer of the Public Service Company of Colorado or the Cheyenne Light, Fuel and Power Company, with the exception of employees of the firms. The Public Service urged that the name be short, one word if possible, and contestants weren't limited in the number of titles they could offer.

On the cover of the small interesting booklet was a photograph, designed for summer, of a lake scene, with a young mischievous bather frightening a young lady bather with a white mouse, while another boy in the water laughs. On the inside cover, Guy Faller, vice-president and general manager, presents a full page message introducing a "new friend." He says: "This brings a new friend into your home—a friend who we hope will be a regular visitor at your house from now on. This little magazine hopes to become a part of your life, providing you with entertaining articles, information about homemaking, news and suggestions about styles and features that will help make living more interesting and enjoyable.

"It is sent you by your own public utility for the purpose of assisting you to better living, just as the public utility, through its service of gas or electricity helps you to more comfortable, happier life. We want you to tell us what you think of this new magazine. We want to know how you think we can make it more interesting and helpful. And then we want you to help us find a name. The details of the Prize Naming Contest are on the next page." And the explanations and rules of the contest appeared on page 3.

The remainder of the book is comprised of articles and pictures. These are on a variety of subjects and all of them are contributions, bought and paid for, just as in a regular magazine. All of the articles are by well-known, recognized writers. The first article, illustrated with photographs, is "Silver Heels," by Edgar



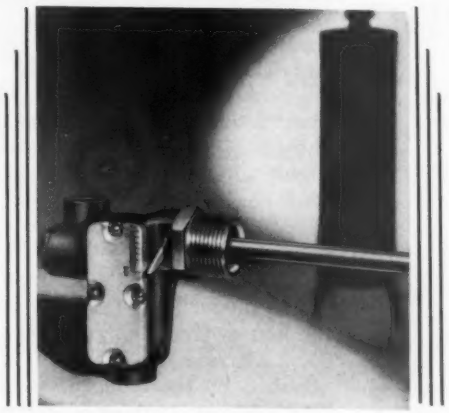
C. McMechen, and tells of the *Bayou Salade*—Mt. Silver Heels on the rim of the great South Park of Colorado.

The second story, "Right Face" is a woman's hat style article by Cornelius Kittredge as told to Arthur J. Lingle, a free lance writer. There are five types of women's faces and five different types of hats for each different face, Cornelius Kittredge says, and it makes very interesting reading. It is illustrated also.

In the middle of the magazine is a double page spread of candid camera studies, entitled "It's Summer." These were taken especially for the Public Service, and show scenes of fishing, boating, golf, tennis, picnics, swimming and horseback riding—altogether a very interesting set of pictures.

"How to Treat a Trout" is the title of another article which was written by Vera Carter Ault, and explains new ways of preparing trout, and also carries illustrations. Vera Carter Ault, Public Service culinary artist in this article invites readers to write or telephone problems of summer parties which will be solved without charge or obligation.

Roy Wright tells of wild horse catching in Arizona in another interesting, illustrated story, and Jean M. F. Dubois, well-known writer tells "How the Snakes Got Their Poison," in the last article in the July issue, Vol. 1, No. 1. But this glance into the contents reveals why Editor Roth says it is not a propaganda sheet and it will maintain good will. And it has all been achieved at low cost for the total sum involved in printing, distribution, purchase of articles and pictures, and editing—because of the volume of the circulation.



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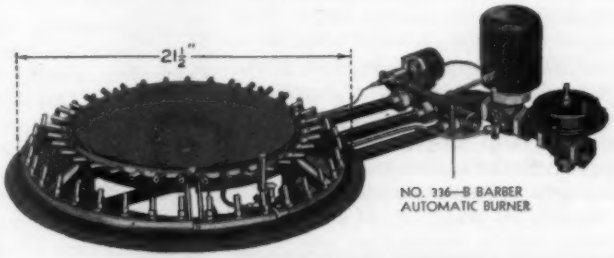

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BARBER *Automatic* JET GAS BURNERS
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Memphis Plan for Boosting Appliance Sales

By Bill Hodges

THERE are no lulls in the Memphis Power & Light Company's efforts to urge householders to use more of its appliances and services. The merchandising, sales and advertising heads are continually plotting to move something from the sales floors into Memphians' homes.

What housewife could resist the urge to "wake up" her kitchen, as she is admonished to do from billboard, newspaper, movie screen and loudspeaker? The Memphis Power & Light Company started its drive to urge Memphians to modernize their kitchens back in the spring, opening, quite naturally, on the modern gas range. This drive has continued, forte being placed at present on such boons to hot-weather cooking on hot plates with interchangeable faces. If housewives at first resented the implication that their kitchens were ever asleep, they readily warmed up to the power company's shiny displays, and admitted (though perhaps silently) that their cooking quarters could stand a blast of the alarm clock.

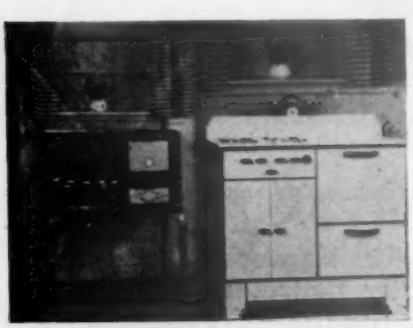
W. H. McInnis and R. C. Anderson, general and residential sales managers of the Memphis Power & Light Company, are continually racking their brains for some new approach to gain the interest of Memphis housewives. They know that new installations, besides creating a direct sale of appliances, are going to stimulate the use and consumption of gas. Chances are that the new appliance will displace some other type of fuel-consumer, thus giving gas a new customer. But even if the swap is a new gas range for an old one, the housewife is apt to spend extra hours cooking on the new affair and will use more gas in the bargain by way of experimentation.

Besides, new and attractive appliances give a new slant on the whole idea of gas. They make customers feel more kindly toward the product, as well as stimulating consumption.

So it is the work of the merchandising manager and advertising manager to cooperate in close harmony in arousing public acceptance and actual response. The operation is a kind of Tinker-to-Evers-to-Chance double play: the merchandise manager starts it, the advertising manager makes the first put-out, and the sales manager tops off the actual sale.

These gentlemen are students of human nature to the extent that they assume that the consummation—the end striven for: the sale—is an accomplishment to be achieved by the cooperation of the three—not by any one link. First, attractive merchandise must be provided; second, the public must be told in no uncertain terms of the benefits to be derived from using said merchandise; and, third, some one must complete the transaction of selling the customer what he wants (after he has been made to want it), by using a little persuasion on occasions. Perhaps there are customers who would buy after simply reading an advertisement. Doubtless some would come into the store and buy whether they saw an advertisement or not. But Memphis Power & Light executives have learned that the way to make sales for profit and in volume is to combine all three forces, making a sure-fire formula.

Eight display trucks are used in sales campaigns, being loaded with appliances and manned by junior salesmen. These youngsters push doorbells in charted territories all over Memphis and invite housewives to inspect a modern gas range, or a space heater at their front doors. There are eight other trucks in the Home Service Department which are used by young women college graduates to visit homes and demonstrate various appliances.

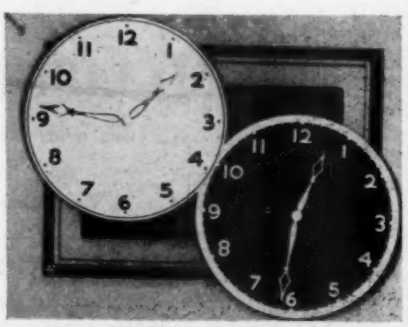


Still from "Screen Broadcasts" movie shorts, contrasting old-type with modern gas range.

Mr. Paul Renshaw, advertising manager, has placed a new type of medium close to the top in the company's appropriations for 1936: "Screen Broadcasts," a recent development in sound motion picture shorts, which, he says, have been highly effective for getting over actual demonstrations of new appliances. These shorts, which run for only a minute or so on a theatre's program, feature the attractiveness of the modern gas range by showing the housewife playing bridge or golf, " . . . thanks to oven-heat control, afforded by the modern gas range." This medium is particularly adapted to contrasting old models and methods with the new, making the advantage of new appliances—whether stoves or waterheaters—highly attractive. Moving clock hands, indicating all 24 hours in the day, imply that constancy of the hot water supply can be maintained with the latest model gas automatic water heater. A double projection is frequently employed to show actual use of the appliance and an accompanying benefit from its use simultaneously.

While Memphis Power & Light Company is bent on selling appliances from its own salesfloors, its campaigns stimulate sales in Memphis generally. It is a common occurrence for the company to sponsor a page in a local newspaper promoting a particular appliance, and while it advertises the appliance in a large ad, there are riders from two, three or four other dealers surrounding the principal ad.

Newspapers and radio carry day-to-day developments in the merchandising and sales campaigns, while billboards carry through the theme of a campaign, admonishing the housewife in brightly-colored boards to "wake up" her kitchen, or asking. "Is there a Chill Chaser in your home?"



Movie short of clock faces, indicating 24-hour hot water service from automatic gas water heaters. In the films, the clock hands are animated.

(Continued from page 21)

6. Why should it be a privilege to talk to a dissatisfied customer?

Chapter—Unit Answers

I. a. To point out the fact that there is an antagonistic feeling toward public utilities in general.
   b. To remind you that your attitude toward the different companies is determined by your feelings toward the people in those companies with whom you deal.
   c. To remind you, also, that in your contacts with a customer, you are the company.
   d. To emphasize the need of proper training in customer contacts among public utility employees.

II. a. In general, because of a lack of understanding of the nature of the business.
   b. Because of the unfavorable publicity directed toward utility companies by politicians, selfish industrial groups, and through the press.

III. a. A fuel that compares favorably with other fuels in cost, convenience and dependability.
   b. A physical service at a reasonable rate.
   c. Appliance to burn the gas safely and efficiently.
   d. A human service that makes him enjoy doing business with the company.

IV. The customer wants recognition from those who serve him. He wants an interest shown in his likes and dislikes. In satisfying human wants, the employee caters to those desires of the customer, and the act increases goodwill automatically.

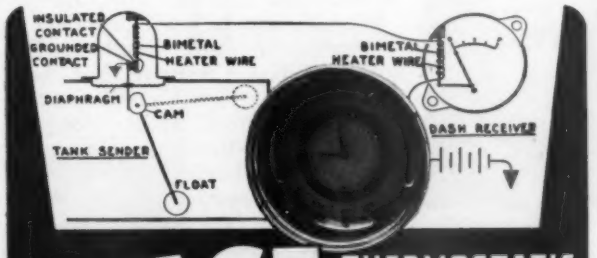
V. The responsibility for goodwill is divided between the company management and the employee. The management can create more goodwill by keeping in close touch with an ever changing public, being informed of its needs, and seeing to it that those needs are satisfied. Also, by making the employee's job more interesting by keeping him informed about those company matters that pertain to the public. The employee's responsibility lies in the proper treatment of a customer.

VI. a. There is an opportunity to make a friend for yourself and for the company.
   b. When you have satisfied such a customer, you enjoy the satisfaction which always follows a good deed.

Radiator Making In Australia

(From our Australian Correspondent)

Messrs. F. Muller Ltd., motor metal workers of Camperdown, Sydney, have, with the assistance of the engineers of the Australian Gas Light Company, evolved a quick economic method of heating in connection with the manufacture and repair of radiators for automobiles. This method includes a battery of high-pressure soldering irons and air blast blow-pipes, all of which are internally heated by gas. For fine repair work and the soldering of the cores of radiators, a very concentrated flame is required to apply the heat at the desired point and nothing else was found suitable for the purpose except gas. The manufacture of radiators calls also for the use of batteries of vats and dipping and tinning baths. All these require to be heated and in some of the operations the temperature control needs to be finely adjusted. Gas has been proved eminently suited to this class of work.



CHACE THERMOSTATIC BIMETAL

used in TELEGAGE

TO INDICATE AMOUNT OF GAS IN AUTO TANK

Above diagram indicates empty gasoline tank. As tank is filled, float raises and cam action forces contact against "Sender" bimetal. This pressure causes electric current to generate heat, bending Chace Thermostatic Bimetal element. Current carried through to "Receiver" bimetal element, bends it and causes indicating needle to record gasoline level on dash of auto. Many of the automatic controls to be found on today's automobiles employ Chace Theromostatic Bimetal as the dependable active element.

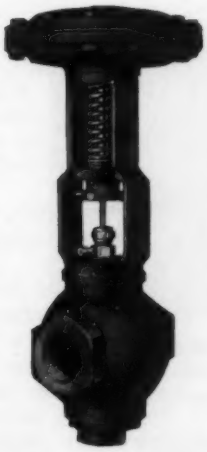
CHACE THERMOSTATIC BIMETAL

W. M. CHACE CO.

1610 Beard Avenue - - - Detroit Mich.

Discharge Pressure Is

CONSTANT



CF

Constant-Pressure PUMP GOVERNOR

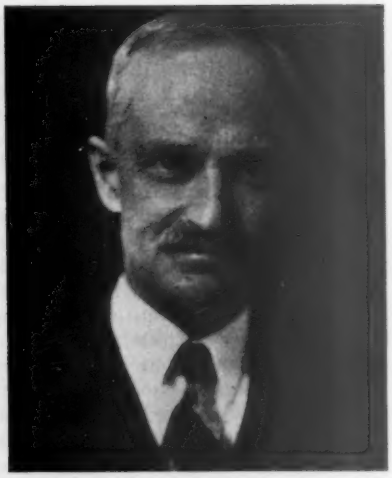
INSTALL the Fulton Constant Pressure Pump Governor in the steam line leading to any steam-driven pump, whether working on oil, ammonia or other liquid, or gas, and it will do just what its name indicates. The diaphragm of the governor is connected to the discharge pipe and any variation of pressure there causes an immediate adjustment of the valve, by which the speed of the pump is controlled. Constant discharge pressure is the result.

Both spring-weighted and lever-weighted types of this governor are offered. Write for catalog.

THE CHAPLIN-FULTON MFG. CO.

28-40 Penn Ave. Pittsburgh, Pa.

Association's Nominating Committee Reports for 1936-37



Herman Russell

IN compliance with Section 2 of Article II of the By-Laws of the American Gas Association, announcement is hereby made to the membership of the following report of the General Nominating Committee which will be presented to the annual convention in Atlantic City, N. J., in October, 1936.

For President — Herman Russell, president, Rochester Gas & Electric Corp., Rochester, N. Y.

For First Vice-President—N. C. McGowen, president, United Gas Public Service Co., Shreveport, La.

For Second Vice-President—Conrad N. Lauer, president, Philadelphia Gas Works Co., Philadelphia, Pa.

For Treasurer—J. F. Rooney, assistant to executive vice-president, Consolidated Edison Co. of New York, Inc., New York, N. Y.

For Directors—2-year terms: Charles W. Bennett, vice-president and general manager, Detroit City Gas Co., Detroit, Mich.

Henry L. Doherty, president, Cities Service Co., New York, N. Y.

O. H. Fogg, vice-president, Consolidated Edison Co. of New York, Inc., New York, N. Y.

F. A. Newton, Commonwealth & Southern Corp., New York, N. Y.

James F. Pollard, president, Seattle Gas Co., Seattle, Wash.

William T. Rasch, president, American Gas Products Corp., New York, N. Y.

W. E. Steinwedell, president, Gas Machinery Co., Cleveland, Ohio.

John K. Swanson, vice-president and general manager, Minneapolis Gas Light Co., Minneapolis, Minn.

Percy S. Young, vice-president, Public Service Electric & Gas Co., Newark, N. J.

N. C. McGowen

Respectfully submitted,

F. C. Freeman, president, Providence Gas Co., Providence, R. I., *chairman.*

Glenn R. Chamberlain, president, Grand Rapids Gas Light Co., Grand Rapids, Mich.

A. Dean Durley, president, Syracuse Lighting Co., Syracuse, N. Y.

Conrad N. Lauer

R. W. Hendee, Colorado Interstate Gas Co., Colorado, Springs, Colo.

H. L. Messer, vice-president, Los Angeles Gas & Electric Corp., Los Angeles, Calif.

F. A. Miller, chairman of the board, S. R. Dresser Mfg. Co., Bradford, Pa.

General Nominating Committee

The following members have been nominated by section nominating committees to serve as section officers for next Association year:

J. F. Rooney

Natural Gas Department: For Chairman—George E. Welker, president, United Natural Gas Company, Oil City, Pa. For Vice-Chairman—Robert W. Hendee, Colorado Interstate Gas Co., Colorado Springs, Colo. Nominating Committee: John B. Tonkin, The Peoples Natural Gas Co., Pittsburgh, Pa. *chairman;* Frank L. Chase, Lone Star Gas Company, Dallas, Texas; George W. Ratcliffe, Pittsburgh, Pa.

Accounting Section: For Chairman—E. J. Tucker, Consumers Gas Co. of Toronto, Toronto, Ont., Canada. For Vice-Chairman—Herbert E. Cliff, Public Service Electric & Gas Co., Newark, N. J. Nominating Committee: A. S. Corson, The United Gas Improvement Co., Philadelphia, Pa., *chairman;* E. B. Nutt, Standard Oil Co. of New Jersey, New York, N. Y.; J. M. Roberts, The Peoples Gas Light & Coke Co., Chicago, Ill.; J. I. Blanchfield, The Brooklyn Union Gas Co., Brooklyn, N. Y.; J. L. Conover, Public Service Electric & Gas Co., Newark, N. J.

Commercial Section: For Chairman F. M. Banks, vice-president in charge of sales, Southern California Gas Company, Los Angeles, Calif. For Vice-Chairman—Hugh Cuthrell, assist. vice-president, The Brooklyn Union Gas Company, Brooklyn, N. Y. Nominating Committee: F. M. Rosenkrans, The Gas Service Co., Kansas City, Mo., *chairman;* W. C. Beckjord, Columbia Gas & Electric Corp., Pittsburgh, Pa.; N. T. Sellman, Consolidated Edison Co., of New York, Inc., New York, N. Y.

Industrial Gas Section: For Chairman—Ralph L. Manier, Syracuse Lighting Co., Syracuse, N. Y. For Vice-Chairman—Hale A. Clark, Detroit City Gas Co., Detroit, Mich. Nominating Committee: J. F. Quinn, The Brooklyn Union Gas Co., Brooklyn, N. Y., *chairman;* W. F. Miller, Public Service Co. of Northern Illinois, Maywood, Ill.; F. B. Jones, Equitable Gas Co., Pittsburgh, Pa.

Manufacturers' Section: For Chairman—John A. Fry, president, Detroit-Michigan Stove Co., Detroit, Mich. For Vice-Chairman, Apparatus Division—Merrill N. Davis, vice-president, S. R. Dresser

Manufacturing Co., Bradford, Pa. For Vice-Chairman, Appliance Division—J. Scott Fowler, president, Lovekin Water Heater Co., Philadelphia, Pa.

Publicity and Advertising Committee: For Chairman—Henry Obermeyer, assistant to vice-president, Consolidated Edison Co. of New York, Inc., New York, N. Y. Nominating Committee: H. W. Olcott, The Philadelphia Gas Works Co., Philadelphia, Pa., *chairman;* D. D. Parry, Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.

Technical Section: For Chairman—M. I. Mix, The Peoples Gas Light & Coke Co., Chicago, Ill. For Vice-Chairman—J. V. Postles, The Philadelphia Gas Works Co., Philadelphia, Pa. Nominating Committee: C. A. Harrison, Toledo Edison Co., Toledo, Ohio, *chairman;* O. S. Hagerman, American Light & Traction Co., Chicago, Ill.; J. A. Perry, The United Gas Improvement Co., Philadelphia, Pa.

Nominees for Section Officers

George E. Welker

E. J. Tucker

F. M. Banks

Ralph L. Manier

John A. Fry

Henry Obermeyer

M. I. Mix

Named for A. G. A. Directorate

Charles W. Bennett

Henry L. Doherty

O. H. Fogg

F. A. Newton

James F. Pollard

William T. Rasch

W. E. Steinwedell

John K. Swanson

Percy S. Young

News of the Industry

Winners in Refrigerator Selling Contest

Victors in the biggest and most successful refrigerator selling contest ever sponsored by the American Gas Association Refrigeration Committee have been announced by B. H. Gardner, chairman of the Committee. Awards amounting to $27,230 have been granted to the winners who have been declared the "leaders" in the contest. A total of 1,044 awards were granted in all. The leaders consist of gas companies and of individual members of sales forces who were ahead in refrigerator sales. Sixty companies shared in the awards.

The highest honors of the campaign were the eight "Swords of Merit" that will be presented to the eight companies who were at the top in their respective divisions. Sword winners were the Washington Gas Light Company, Washington, D. C.; Gas and Electric Appliance Company, Columbus, Ohio; Detroit City Gas Company, Detroit, Mich.; Cumberland and Allegheny Gas Company, Cumberland, Md.; Manufacturers Light and Heat Company (Ellwood City District), Bellevue, Pa.; North Penn Gas Company, Port Allegeny, Pa.; Lynchburg Gas Company, Lynchburg, Va.; and Broad River Power Company, Florence, S. C. These trophies were in addition to the highest awards granted to company winners.

Presentation of the "Swords of Merit" will take place at the annual convention of the American Gas Association to be held in Atlantic City, week of October 25th.

The success of the campaign is a source of satisfaction to the Committee because of its benefit to the whole gas industry, in view of the greatly increasing acceptance of gas refrigeration which is one of the prime results of its selling campaigns. Each campaign has been larger than its predecessor. Nearly 600 companies, representing nearly 10,000,000 meters, participated in the "Sword of Merit" campaign.

The contest was conducted in collaboration with Servel, Inc., manufacturers of Electrolux refrigerators, and the Committee gives high praise to that company for its promotional and advertising activities which were such important factors in making the campaign so successful.

Company winners of awards standing second in the final results were: Kings Appliance Corporation, Brooklyn, N. Y.; Providence Gas Company, Providence, R. I.; Milwaukee Gas Light Company, Milwaukee, Wis.; Manufacturers Light and Heat Company, East Liverpool, Ohio; Southern Indiana Gas and Electric Company, Evansville, Ind.; Rosslyn Gas Company, Clarendon, Va.; Virginia Gas Distribution Corporation, Staunton, Va., and Arkansas Louisiana Gas Company, Vivian, La.

Companies winning awards through standing third were: Consolidated Edison Company of New York; New Haven Gas Company, New Haven, Conn.; Minneapolis Gas Light Company, Minneapolis, Minn.; Springfield Gas Light Company, Springfield, Mass.; Birmingham Gas Company, Birmingham, Ala.; Natural Gas Company of West Virginia, Wheeling, W. Va.; Peoples Gas Company, Port Arthur, Texas; United Gas System, Sinton, Texas, and Manufacturers Light and Heat Company (Chester District), East Liverpool, Ohio.

Fourth place was gained by the following: Southern California Gas Company, Los Angeles, Calif.; Brooklyn Borough Gas Company, Coney Island, N. Y.; Hartford Gas Company, Hartford, Conn.; Arkansas Louisiana Gas Company, Little Rock, Ark.; Central States Power and Light Corporation, Tulsa, Okla.; Manufacturers Light and Heat Company (Rochester District), Bellevue, Pa.; Tyler Gas Service Company, Tyler, Texas, and Virginia Gas Distribution Corporation, Waynesboro, Va.

Companies winning awards through standing fifth were: Brooklyn Union Gas Company, Brooklyn, N. Y.; Public Service Electric and Gas Company, Newark, N. J.; Southern Counties Gas Company, Santa Ana, Calif.; Montana-Dakota Utilities Company, Minneapolis, Minn.; Manufacturers Light and Heat Company (Beaver Falls District), Bellevue, Pa.; United Gas System, Harrisburg, Texas; and Gas and Electric Appliance Company, Caldwell, Ohio.

Companies that received sixth place awards were: Western United Gas and Electric, Aurora, Ill.; Ohio Fuel Gas Company, Mansfield, Ohio; Manufacturers Light and Heat Company, Bellaire, Ohio; Ohio Fuel Gas Company, Baltimore, Ohio; United Gas System, Childress, Texas, and Central Electric and Telephone Company, Columbus, Nebraska.

Seventh place awards went to the following: Metropolitan Utilities District, Omaha, Nebr.; Bridgeport Gas Light Company, Bridgeport, Conn.; Houston Natural Gas System, Houston, Texas; Manufacturers Light and Heat Company, Washington, Pa.; Keystone Gas Company, Inc. (Olean District), Olean, N. Y., and Piedmont Gas Company, Hickory, S. C.

Companies winning awards for standing eighth were: Elizabethtown Consolidated Gas Company, Elizabeth, N. J.; Manufacturers Light and Heat Company, Pittsburgh, Pa.; Natural Gas Company of West Virginia, Salem, Ohio; Lowell Gas Light Company, Lowell, Mass.; Hornell Gas Light Company, Hornell, N. Y.; Gas and Electric Appliance Company, Cambridge, Ohio; and Gas and Electric Appliance Company, Amherst, Ohio.

Special high cash awards were granted to three companies that made exceptional records in the "installations per 10,000 meters" class. These were the Washington Gas Light Company, Washington, D. C.; Providence Gas Company, Providence, R. I.; and Springfield Gas Light Company of Springfield, Mass.

In this campaign home service departments were offered awards for the first time: the winners were the home service departments of the Washington Gas Light Company, Gas and Electric Appliance Company, Providence Gas Light Company, Detroit City Gas Company and the Springfield Gas Light Company.

The individual cash awards went to 983 sales people and they included awards for monthly records and for total sales performance throughout the entire contest.

Average total installations for individual leaders in sales for the whole period of the campaign were 60 refrigerators. Awards ran as high as $100 for first position down to $10 for the tenth position. All final retail sales leaders who made a better-than-average record received either the first or second year gold Medal of Merit.

Individuals at the top—the hundred dollar winners—in their respective divisions were: J. F. Onley, Washington Gas Light Company; Thomas Green, Providence Gas Company; Larry A. Deabler, Hartford Gas Company; J. B. Billard, Cumberland and Allegheny Gas Company; Theodore B. Sills, Manufacturers Light and Heat Company (New Castle-Ellwood City District); W. R. Bales, Ohio Fuel Gas Company; E. V. Bowyer, Lynchburg Gas Company; and E. H. Enochs, Arkansas Louisiana Gas Company.

Ohio Supreme Court Fixes 55 Cent Gas Rate for Columbus, O.

A recent decision of the Ohio Supreme Court fixes the gas rate for Columbus, O., at 55 cents. The decision was based upon an ordinance passed by the Columbus City Council and approved by voters in 1929, establishing a 48-cent rate.

The 55-cent rate was set by the Ohio Public Utilities Commission seventeen months ago for the city.

The court's decision of June 21, 1933, holding the 48-cent rate adequate as claimed by the city, was reversed. The court voted 5 to 2.

The case has been before the utilities commission twice, the Ohio Supreme Court three times and the United States Supreme Court twice.

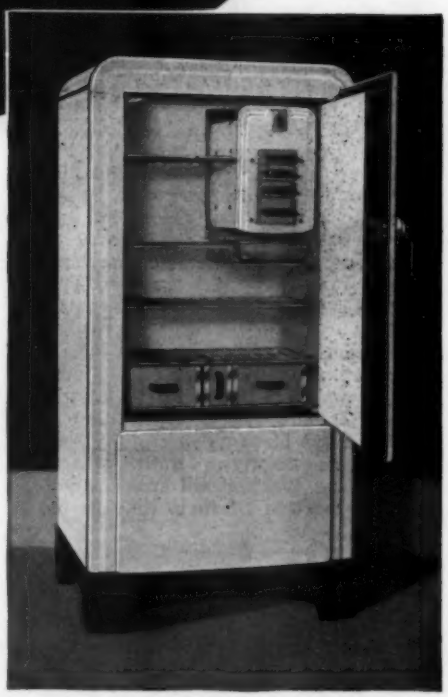
Lawrence Jaros With W. J. Schoenberger Co.

Lawrence Jaros, testing engineer in the space heating section of A.G.A. Laboratory since May, 1934, has been employed by the W. J. Schoenberger Company, gas burner valve manufacturers of Cleveland, Ohio. He will assist Casper S. Stuckenholt, also a former laboratories employee, in the engineering department of the Schoenberger organization.

AS SOUTHERN CALIFORNIA GOES

so goes the trend of the nation!

ELECTROLUX
CONTINUES TO OUTSELL
ANY OTHER REFRIGERATOR IN
SOUTHERN CALIFORNIA



The companies which made this record are

SOUTHERN CALIFORNIA GAS CO. SOUTHERN COUNTIES GAS CO.
LOS ANGELES GAS AND ELECTRIC CORPORATION

AGAIN THIS YEAR, gas refrigeration has won an outstanding vote of approval in Southern California! This continued success is significant of what intelligent and aggressive sales promotion can do. And it's significant, too, of the ever-growing preference for this modern gas appliance in all parts of the country.

In the face of the strongest kind of competition, gas companies everywhere are *Marching to Leadership with Gas Refrigeration!* The past six months have seen the record-breaking sales and merchandising achievements of 1935 *topped* by even greater achievements. In section after section, there has developed a definite trend to Electrolux, the gas refrigerator... and this trend is fast becoming nation wide.

More sales this summer

The hot summer months just beginning offer a psychological time to *press* this victory for gas refrigeration. Months when families will realize more than ever their need for efficient food protection ... will desire the convenience of ice cubes always on hand. Months when your salesmen can bring home to these families, opportunely, the big unmatched advantages of Electrolux's different, simpler operating method.

Servel, Inc., Electrolux Refrigerator Sales Div., Evansville, Ind.

New Air-Cooled **ELECTROLUX**
THE SERVEL *Gas Refrigerator*

Leslie Fairchild Asst. General Manager, Sprague Meter Co.

At a recent meeting of the Board of Directors of The Sprague Meter Co., of Bridgeport, Conn., Mr. Leslie Fairchild, Engineer of the company

Leslie Fairchild

for the past seven years, was appointed Assistant General Manager effective July 1. Mr. Fairchild, who is well known to the Gas Fraternity, has been associated with the company twenty-four years, having entered their employ as draftsman in 1912.

A. F. Rucks Appointed General Manager of Tagliabue Company

The C. J. Tagliabue Mfg. Co. of Brooklyn, N. Y., has announced the promotion of A. F. Rucks to position of General Manager.

Mr. Rucks has been associated with the Tagliabue Company for over 23 years and has gained notable experience in practically every phase of the Tagliabue Company industrial instrument business.

The company also announces the appointment of W. C. Bennett as General Sales Manager in charge of the Eastern Territories, and Mr. E. D. Wacker as General Sales Manager in charge of the Western Territories. Both Messrs. Bennett and Wacker will spend a considerable portion of their time in the field.

Armin O. Schleiffarth with Laclede Christy Co.

Laclede Christy Clay Products Co., St. Louis, announces the appointment of Mr. Armin O. Schleiffarth as manager of its Flat Suspended Arch and Supported Wall Division.

A licensed professional engineer in the State of New York, Mr. Schleiffarth joins the Laclede organization after eight years with the Improved Equipment-Russell Engineering Co., of New York City where he served in the capacity of Engineer in Charge of Construction.

Julius Kahn with Republic Steel Corp.

Julius Kahn, who has been president since his founding of Truscon Steel Corporation 33 years ago, has resigned his position to become vice-president in charge of Product Development of Republic Steel Corporation.

F. N. Dillman Now Sales Engineer of Pittsburgh Equitable Meter Co.

The Pittsburgh Equitable Meter Company, Pittsburgh, Pa., announces the appointment of F. N. Dillman as sales engineer.

After graduation from Kansas State University in 1924, Mr. Dillman joined the Kansas State Highway Department as a civil engineer. Since then he has been engaged in various types of sales work. For the two years prior to joining the Meter Company, he was with

F. N. Dillman

the Continental Oil Company in the sales division.

Mr. Dillman will work out of the Tulsa, Okla., office and will be in charge of EMCO-McGaughy Integrator Sales and Service under the supervision of J. L. Cottrell.

Divisions Merged

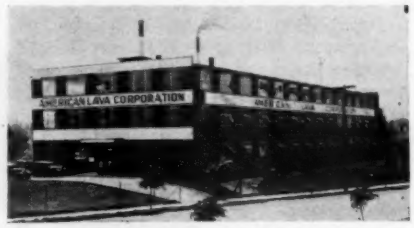
The Domestic Appliance Maintenance Division and the Commercial Appliance Maintenance Division of the Consolidated Edison Company of New York, Inc., have been merged into a single unit called the Appliance Maintenance Division.

Frank E. Vilas, who was superintendent of the domestic division, heads the new set-up, with a force of nearly 700 men. His assistants are William M. Leonard, Chevis L. Wray, and Louis C. Hornbostel. The scope of the work done by the men in the new appliance maintenance division is being broadened gradually, including the addition of some electrical work.

Arthur V. Hay, who was superintendent of the commercial division, will assist in reorganizing the merged forces, and then will join the Sales Department, taking charge of the utilization forces attached to the Hotel and Restaurant Division and Industrial Division.

New Plant of American Lava Corporation

Illustration shows the new daylight flooded plant of the American Lava Corp., Chattanooga, Tenn., which con-



tains adequate research laboratory, and has three times the capacity of the old plant. Paul Kreusi has been president of the company for 35 years.

Butane Plant at Union Springs, Ala.

J. B. McCrary & Company of Atlanta have been awarded a $44,103.90 contract to build a butane gas plant at Union Springs, Ala. Work will begin as soon as funds are released by the PWA.

The contract which must be completed within 120 days calls for the erection of a larger storage tank and the laying of a pipeline distribution system. The gas will be shipped to the city in tank cars.

New Orifice Fitting Announced

A new orifice fitting known as "Type E," for handling gases and liquids is announced by Robinson Orifice Fitting Co., of Los Angeles. The main operating mechanism, which is entirely enclosed in the upper chamber, consists of a heavy stationary screw and a follower nut, pivoted to the orifice plate carrier. This simple device raises or lowers the orifice plate carrier and forces the carrier into its position in the lower seats. When the plates are to be inspected or changed, the carrier is lifted completely out of the upper chamber and is held in a convenient position for servicing.

The valve seats are covered in both open and closed positions. A full-floating plug valve is lubricated with an equalized pressure system. It is never necessary to lift the carrier manually because it is supported at all times. The orifice fitting has a quick change cover plate. Positive control of the orifice plate is maintained under all pressures. An indicator definitely shows the operator when the orifice plate is positioned in the pipe line bore. The orifice plate may be locked in place, preventing unauthorized changing of orifice plate setting.

New Officers of Public Utilities Advertising Association

At the annual convention of the Public Utilities Advertising Association, held in Boston on June 30 in conjunction with the annual meeting of the Advertising Federation of America, the following officers were elected:

President—D. D. Parry, Central Hudson Gas and Electric Corporation, Poughkeepsie, New York.

First Vice-President—Kenneth Magers, Union Gas and Electric Company, Cincinnati, Ohio.

Second Vice-President—Howard F. Weeks, Consolidated Edison Company of New York, Inc., New York.

Third Vice-President—E. K. Hartzell, Lake Shore Electric Railway Company, Sandusky, Ohio.

Secretary—H. W. Olcott, Jr., Philadelphia Gas Works Company, Philadelphia, Pa.

Treasurer—H. C. Cannon, Brooklyn Union Gas Company, Brooklyn, N. Y.

The following directors were elected for three year terms:

Thomas H. Spain, Public Service Electric and Gas Company, Newark, N. J.

H. J. Rowe, Iowa Electric Light and Power Company, Cedar Rapids, Iowa.

Will C. Grant—Lone Star Gas System, Dallas, Texas.

J. C. MacDonald of the Edison Electric Illuminating Company of Boston was elected a director to fill unexpired term of one year.

The annual awards in the Association's Better Copy Contest were announced by Kenneth Magers, of the Union Gas and Electric Company, Cincinnati, Ohio, chairman of the Better Copy Committee.

There were seventeen classifications in the contest—four for gas companies, four for electric companies, one for gas and electric companies, two for transportation companies, and six for all public utility companies.

The awards to gas companies announced by Mr. Magers were as follows:

Load Building Newspaper Advertising for Gas Companies

Premier Award—The Peoples Gas Light & Coke Company with the Public Service Company of Northern Illinois, Chicago, Ill.

Award of Excellence—Wisconsin Public Service Corporation, Oshkosh, Wis.

Award of Excellence—Syracuse Lighting Company, Syracuse, N. Y.

Public Relations Newspaper Advertising for Gas Companies

Premier Award—Consolidated Edison Company of New York.

Merchandise Newspaper Advertising for Gas Companies

Premier Award—British Columbia Electric Railway Company, Vancouver, B. C.

Award of Excellence—New York Power and Light Corporation—Niagara Hudson Sys.

Newspaper Advertising for Gas and Electric Companies

(Six Special Awards for Copy and Idea Excellence Only)

Premier Award—Consolidated Edison Company of New York (Two Awards).

Premier Award—Iowa Electric Light & Power Company, Cedar Rapids, Iowa.

Premier Award—Philadelphia Gas Works Company, Philadelphia, Pa.

Premier Award—Wisconsin Public Service Corporation, Oshkosh, Wis.

Premier Award—Texas City Gas Company.

Window or Inside Displays for Gas Companies

Premier Award—Philadelphia Gas Works Company, Philadelphia, Pa.

Award of Excellence—Consolidated Edison Company of New York.

Award of Excellence — Brooklyn Union Gas Company, Brooklyn, N. Y.

Radio Advertising

Premier Award—Consolidated Edison Company of New York.

Award of Excellence—Philadelphia Company, Pittsburgh, Pa.

Award of Excellence—Rochester Gas and Electric Corporation, Rochester, N. Y.

Coming Events

August

25-27 Pacific Coast Gas Association, 43rd annual convention, Fairmont Hotel, San Francisco, Calif. Clifford Johnstone, managing director, 447 Sutter St., San Francisco

October

1-2 Empire State Gas and Electric Association, annual convention, Saranac Inn, Saranac, N. Y.

Week of October 25 American Gas Association, 18th annual convention, Atlantic City N. J. Alexander Forward, managing director, 420 Lexington Ave., New York.

October 25-30, Inclusive, Exhibition of Gas Appliances and Equipment at the First Annual Convention Association of Gas Appliance and Equipment Manufacturers in Affiliation with the Eighteenth Annual Convention of the American Gas Association, Atlantic City Auditorium, Atlantic City, N. J.

New Primary Air Mixer

Invention No. 358,098 has been awarded to A. J. Markham, Gas Engineer, City of Toronto, Canada, graduate of the City Guild Institute, London, England, covering design for new primary air mixer, which eliminates flashback in the burner. The illustration shows the mixing chamber cut away from the burner and reversed. There are separate primary air conduits running at right angles to the flow of gas. Primary air conduits with adjustable sleeve is shown in circle. The primary air being induced by the flow of gas is broken into sections and conducted through tubes set at an obtuse angle to the flow of gas. As a result the pressure exerted by unforeseen conditions arising through atmospheric disturbances cannot interrupt or disturb the flow of gas. The circular air movement set up around the injector keeps the point of delivery cool and therefore efficient. This also keeps the plugs of gas-cocks efficient because expansion is reduced. Great Britain has adopted this patent.

Morris E. Leeds Receives the Henry Laurence Gantt Gold Medal

Morris E. Leeds, President of Leeds & Northrup Company, Philadelphia, was the recipient this year of the Henry Laurence Gantt Gold Medal awarded annually by the Institute of Management "for distinguished achievement in industrial management as a service to the community." Henry S. Dennison, who received the award in 1932, presented the Medal to Mr. Leeds.

Morris E. Leeds

Long a keen student of human relations in industry, Mr. Leeds is widely known for his far-sighted philosophy of the factors which underlie harmony between employer and employee. In the Leeds & Northrup plant, a Cooperative Association in which every employee has a vote, has functioned since 1918. An elected Council represents the employees in all their dealings with the Management, and in addition has charge of a variety of employee activities over which the Management exercises no supervision. Because its meetings are not attended by Management's representatives, this Council is singularly free to determine employee opinion in its true light, and to express such opinion freely to the officers of the Company. For eighteen years, Council and Management have cooperated successfully, both in matters of general policy and in specific instances, to promote mutually satisfactory employer-employee relations.

Specific committees of Council investigate matters pertaining to wages and hours, time study, safety, general working conditions, etc. There is an Appeal Board which reviews cases of discharged employees. An Educational Plan, financed by the Company, through which employees are reimbursed for half of the tuition for night school courses successfully completed, is administered by a committee of Council.

Thus the Company, of which the man to whom the Gantt Award has just been made, is president and founder, has attempted to put into practice a broad policy of justice to all concerned, with equal opportunity for each employee to rise to that level of reward and power for which he is qualified.

Semet-Solvay Eng. Corp. Gets Pipe Line Contract

The Great Lakes Steel Corporation has awarded a contract to the Semet-Solvay Engineering Corporation, of New York, for the building of a pipe line which will convey blast furnace gas from the Hanna furnaces, on Zug Island, to the Delray plant of the Detroit Edison Company.

The gas line will be 48 inches in diameter and will be of welded steel construction. The line will start at the Hanna Furnace plant and cross the Rouge River over a new bridge, to be constructed, and which is a part of the undertaking. It will then run some 2,400 feet to the Edison property.

The river crossing will be approximately 200 feet and will clear the high water line by 150 feet.

The pipe will be fabricated in the Semet-Solvay Engineering Corporation shops at Owosso, Michigan. Work is scheduled to start at once.

Officers of Society of Gas Engineers

James S. Kennedy, construction engineer with the Consolidated Edison Company of New York, was elected president of the Society of Gas Engineering of that company at its recent annual meeting. He is a charter member of the society, which dates back to 1905.

Fred B. Cadmus, assistant general superintendent of the Hunts Point Plant, was elected vice-president; William C. Oeckler, assistant general superintendent of the Customers' Service Department, treasurer; and Fred Glaeser, engineer's assistant in the Construction Department, secretary.

The new executive committee consists of Oliver H. Smith, assistant engineer of manufacture, chairman, and former president of the society, Charles A. Lunn, chief chemist, and Nils T. Sellman, assistant vice-president.

New Radiator Vent Valve

American Rediator Company, New York, has announced the development of a new radiator vent valve, with adjustable vent port for balancing the distribution of heat throughout the house, and a new quick vent valve for rapid venting of steam mains. Both the radiator and main vent valves are made for either one pipe steam or vaccum systems.

By setting the valves of the radiators nearest the boiler so that they vent air slowly, and by opening the valves on the radiators at a more distant point from the boiler, and increasing this opening as the distance increases, so that they vent air more quickly, all radiators are filled simultaneously with their quota of steam and heat is evenly

distributed to all rooms. The quick vent valve on the end of the steam main allows steam to be supplied almost instantly to the riser connections leading to the more remote radiators as well as the ones adjacent to the boiler.

Both the Variport Airid, for one pipe steam systems, and the Variport Vacuum, for vacuum systems, offer a wide range of venting rates and can be easily adjusted by removing the protective cap on top of the valve and turning the adjustment dial with coin, screw driver or key to any desired opening. The adjustment dial is plainly marked to show minimum, maximum and normal venting rates.

Condensation Eliminator

Condensation Engineering Corp., 335 S. Western Ave., Chicago, Ill., announce the Condensation Eliminator and Vitrified flue lining to eliminate condensation and its effect upon chimneys where gas is used as a fuel. They state:

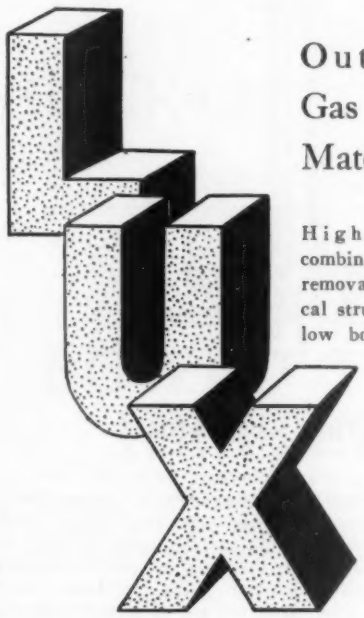
"The products of combustion from manufactured gas contain approximately 6 gallons of water to each 1000 cubic feet and 12 gallons in each 1000 cubic feet of natural gas. This water content is in the form of vapor when it leaves the combustion chamber of the heating plant on its way to the chimney.

The products of combustion from manufactured gas, and of some natural gas, contain Sulphurous acid and the destructive action of this acid is too well known to those familiar with gas-house-heating. The solution of Sulphur Dioxide continues until quite a high concentration of the acid is reached. Similarly, carbon dioxide dissolves in the water, making the solution contain a mixture of the sulphur acids with carbonic acid.

The presence of the acidulated condensate causes the destruction of the clay tile linings, brick and mortar, as well as the metals used for the vent connections between the appliance and the chimney. Flue linings made of fire clay disintegrate and fall to the bottom of the chimney, sometimes shutting off the outlet for the products of combustion. In the colder climates the problem of freezing and cracking the masonry work of unlined chimneys is also a hazard.

Warm air will carry a much larger con-

(Continued on page 44)



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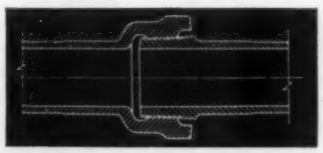

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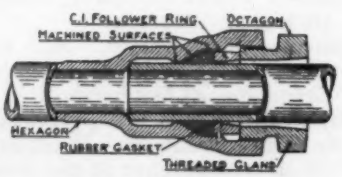

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PACIFIC STATES CAST IRON PIPE CO. PROVO, UTAH

Branch Offices: Chicago, Dallas, Denver, Kansas City, New York, Portland, Ore., Salt Lake City, San Francisco, Los Angeles

(Continued from page 42)

tent of water in vapor form than cold air therefore, under the present practice it is necessary to keep the flue temperature above the "Dew Point" all the way to the top of the chimney to prevent the above named troubles which means a high stack loss.

The Condensation Eliminator and Vitrified flue lining will completely solve this vexatious problem. This device was developed on the principle of re-evaporation and it was necessary to eliminate the draft diverter for this reason. It was found that the draft diverter permitted a large volume of room temperature air to escape up the flue, reducing the temperature of the flue gases and materially increasing the amount of condensation. The Condensation Eliminator has a back draft door which opens when there is a down draft and is so constructed that it automatically closes when the back draft subsides. It is also equipped with a door that controls the up-draft and can be set at any point desired for this purpose.

When the furnace is first lighted there is considerable condensation and it collects in the bottom of the Condensation Eliminator and after the furnace warms up the temperature rises in the Condensation Eliminator above the boiling point and it is re-evaporated. The average spent-gas temperatures leaving the heating plant varies from 300 to 400 degrees Fahrenheit and by eliminating the cold air drawn into the flue through the conventional draft diverter, this heat is utilized for carrying away the water vapor.

The Condensation Eliminator and Vitreous Enamel flue lining are made of heavy enameling stock iron and finished with acid resisting vitreous enamel that will not corrode under the conditions for which it is made."

Complete description can be had by addressing the manufacturer.

New Officers of Michigan Gas Association

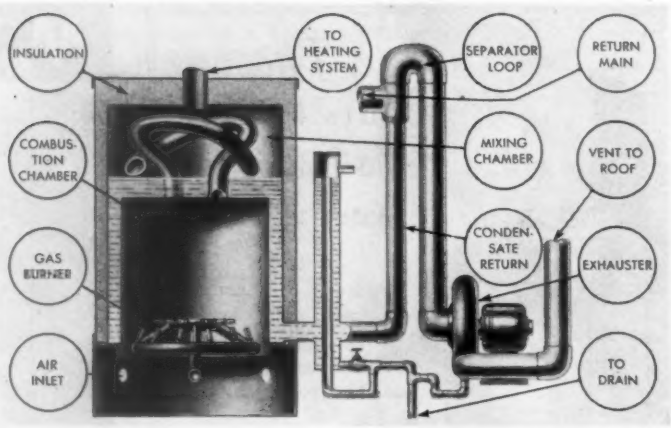
The following officers were elected for the coming year at the closing session of the annual convention of the Michigan Gas Association held at Mackinac Island, Michigan, July 6, 7, and 8, 1936:

President, Newell E. Loomis, Detroit City Gas Company, Detroit, Michigan.

Vice-President, Howard Pett, Consumers Power Company, Lansing, Michigan.

Secretary - Treasurer, A. G. Schroeder, Grand Rapids Gas Light Co., Grand Rapids, Michigan.

Mr. Loomis was first employed by the Detroit City Gas Company in 1908 as stenographer in the New Business department. Later he became secretary to the sales manager, secretary to the assistant general manager, and in 1914 was promoted to executive ranks as superintendent of coke sales. In 1923 he was made assistant sales manager and in 1932 merchandise sales manager, which position he now holds. Mr. Loomis has served on many committees of the Michigan Gas Association and the American Gas Association.



New Heat Generating Apparatus

C. A. Dunham Co., Chicago, Ill., announce a heat generating apparatus, burning either manufactured or natural gas under automatic control. It applies to existing hot water systems, replacing coal or oil fired boilers, and is called "Sav-T-heat." The heat generating apparatus, burning gas under automatic control, is a new method of using gas without the usual chimney waste of heat. The mixture of vacuo-vapor is circulated through the radiator system under slightly lower pressures than that of the atmosphere by an exhauster. The sectional diagram shows how the gas is mixed with vapor. Descriptive matter will be mailed on request to the manufacturer.

New Heating Rate Approved

By a vote of three to two, the State Department of Public Utilities has ordered No. 2 rates, so-called, of the Boston Consolidated Gas Co., Boston, Mass., to be changed so that the minimum bill per year for gas used in space heating shall be $100 instead of $75, the new rate to become effective Aug. 1. This is a house-heating rate and is conditioned upon the customer paying a minimum amount for gas used for space heating only, regardless of whether the allotted amount is used.

Book Review

Public Utility Financing 1930-1935, by Mervin H. Waterman, Assistant Professor of Finance and Assistant Director Bureau of Business Research of the University of Michigan. Michigan Business Studies Volume VII, Number 4. 144 pages. Price $1.00.

This work by Professor Waterman deals with "the financial practices of the utilities as they are reflected in the purposes and uses of security, contracts and in the financial relationships between operating and holding companies."

Consideration of the financial implications of holding company affiliations is based on observation of a number of particular point of financial contact between public utility holding companies and subsidiaries. The effectiveness of parental financial aid is questioned with a view to determining its possibilities and limitations. Further, this monograph contains the results of a detailed study of the effects and financial significance of diversification as a means of stabilization in the utility industry.

Analysis of utility financing which took place during the year 1930 to 1935 leads to some interesting and significant observations regarding financial policies in the utility industry. During this period there was a complete change of motivation which was closely related to the economic and political phenomena of the depression. With the advent of recovery, the utilities were still handicapped by factors which precluded the sale of other than refunding issues. This study examines the economic and legal conditions of the investment market, as well as those pertaining to the utility industry itself, which led to changes in capital contracts with regard to type, form of security, provisions for retirement, etc. Security registration, bankers' spreads and competitive bidding are among the specific factors discussed as affecting capital costs to the industry and the quality and yield of securities offered to investors.

Professor Waterman's analysis of recent utility financing takes cognizance of the fact that the capital characteristics of utilities, together with holding company domination in the field, have caused the utility business to be "vested with a public interest" quite different from that to which legalists refer to their discussions of utility regulation.

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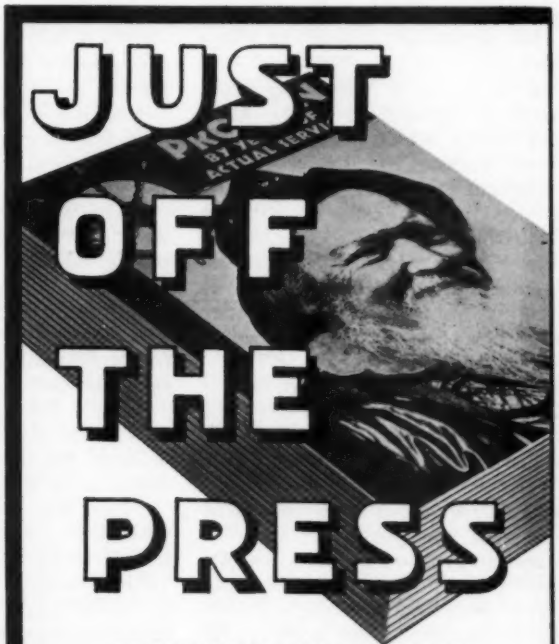

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Brooklyn, N. Y.

(Continued from page 30)
other early mast guided holders and for the prints of several of these holders.

One of the most interesting from a historical standpoint is the mast guided holder which was in service for many years at the Soho Foundry, Birmingham, England, where Murdock introduced gas for lighting in 1802. Although some doubt exists there are many who believe that the holder as photographed in 1910 was the original holder. The same holder photographed in 1926 shows considerable deterioration.

Another center post holder is known to have been built at the plant of the Boston Gas Light & Coke Company, Boston, England, in 1825. The arrangement of the Counterbalance structure of this holder obscures the view of the post.

A unique type of holder previous to the invention of the telescopic holder is described in King's Treatise as Strattons double holder. As may be seen from the accompanying picture the inner holder is pulled up and filled with air by the fall of the outer holder. The inlet and outlet pipes were between the two shells. The central guide inside of holder is clearly shown. According to Mr. Humphreys it is doubtful whether any of this type were ever built.

Peckston's Theory and Practice of Gas Lighting, printed in 1819, says John Malam contributed largely to the improvements in construction of cylindrical gas holders, by dispensing with heavy internal framing, in applying counter-balance weights and chains for relieving the pressure, and guiding the holder by a center rod and tube. This last system was extensively adopted in gas holders for small works.

King's Treatise on Gas Lighting, says John Malam built mast guided holders for small works and that many were still in use in 1879.

From Mr. J. A. Messenger of the United Engineers and Constructors, Philadelphia, we learn of two mast guided holders which were located in Philadelphia, one at the Northern Liberties Gas Works and the other at the old Frankford Works of the Philadelphia Gas Works Co. The Northern Liberties holder had been constructed by an English firm about 1835, all of the sheets having been brought over from England and the holder erected in this country. The lift of this holder was removed from the pit in 1912 under the direction of Mr. Messenger.

The photograph of a mast guided holder was at the old Frankford Works of the Philadelphia Gas Works Company at the time the operation of the Philadelphia Gas Works was taken over by the United Gas Improvement Company. This photograph was taken in 1898 at which time the holder was still in operation. The Frankford Holder was exactly the same type as the Northern Liberties holder and was perhaps manufactured at the same time and by the same people who manufactured and erected the holder at Northern Liberties.

Tangible & *Intangible*

WHAT *is* that Intangible called "goodwill"? *"Goodwill,"* says the Supreme Court, *"is the disposition of the pleased customer to return to the place where he has been well treated."* Repeat orders for G.P.M. Iron Hydroxide in 1936 to date exceed one million bushels. This is the tangible proof of that intangible quality "goodwill."

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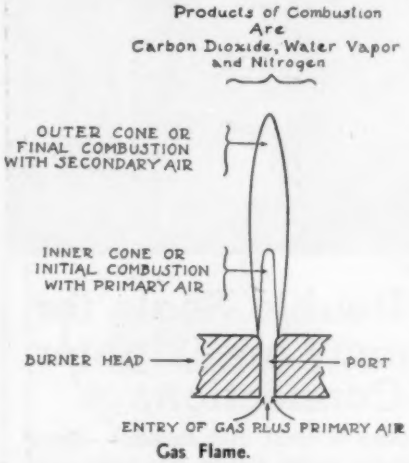
(Continued from page 12)
of the air requisite to combustion is supplied as secondary air from the outside atmosphere surrounding the flame[5].

Occasionally backfiring is not due to bad adjustment of either the orifice spud or the air shutter. We have observed that backfiring is caused by too great a proportion of primary air, i.e., too lean a mixture. This satisfactorily explains the reason for backfiring when burners are manually lighted by incorrect method. Where burners are lighted by hand, customers should be instructed to turn burner on full, waiting for from 3 to 5 seconds before applying a match. This procedure permits the expelling, or pushing out, of the air lying in the idle burner before ignition is made available to a properly proportioned mixture. It is, therefore, possible to have backfiring without incorrect burner adjustment.

Discussion up to this point has been concerned with conditions affecting, or produced by, the orifice, the air shutter and the mixing head. Basically, these factors reviewed control the air-gas mixture comprising the gas input and the primary air. It remains for us then to investigate the burner head, ports and the flame itself. The flame will first be analyzed as to chemical process and as to appearance to assist in visualizing



Gas Flame.

which the accompanying drawing entitled "Gas Flame" is included. In this sketch gas is shown emerging through a drilled port in the burner head. The gas on being lighted, burns in two concentric cones whose bases start at the exit of the ports. The inner cone results from chemical combination of the oxygen contained in the primary air with the gas, whereas in the outer cone the final stages of combustion are completed by combination with the secondary air.

The mixture entering the drilled ports is made up of the gas injected by the orifice and the primary air sucked in through the air shutter and mixing head. The gas and air are thoroughly mixed one with the other as the same progress down the mixing tube. Depending upon the kind of gas injected, the two basic chemical elements are hydrogen and carbon in varying percentages (oxygen is likewise present, usually in combination with carbon in the form of carbon monoxide or carbon dioxide). The carbon is grouped in combinations with hydrogen making up such gaseous substances as methane (CH_4), ethane (C_2H_4) and illuminants (i.e., ethylene, propylene, etc.). Most manufactured gases have a high percentage of free hydrogen and carbureted water gas also has a relatively high carbon monoxide content. However, most salesmen are scarcely interested in the chemical analysis of gases other than to know that, depending upon the kind of gas, the constituents vary and also that combustion is essentially a process of rapid oxidation in which the oxygen of the air combines with the basic ingredients of the gas (mainly hydrogen and carbon that are common to all gases) to form two simple and common resultant gases, water vapor and carbon dioxide. Of course, the nitrogen which, together with oxygen, constitutes ordinary air, goes through the process without chemical change. Then, irrespective of the type of gas, the final products of combustion in a top burner are always water vapor (H_2O), carbon dioxide (CO_2) and nitrogen (N_2). The problem of interest is that which happens in bringing about the change from the primary air-gas mixture entering the ports to the final products of combustion.

As previously intimated, the oxygen contained in the primary air is completely absorbed into combination while burning within the so-called inner cone. This first zone of combustion, or inner cone, rises to a height, with a properly adjusted, star-shaped burner, of about ½" in contrast to the outer cone of about 1¾", both of which are sharply defined and distinct in outline. The inner cone is bright green verging on to a blue in color. The exact chemical change occurring during this first, or inner, zone of combustion is not entirely known[6], but it has been established that such oxygen as is introduced via the primary air undergoes a combination with the gas, thus leaving no free oxygen at the conclusion of the inner cone combustion.

In the outer cone, final combustion is completed to the inevitable and final water vapor and carbon dioxide, after which process, all of the useful heat may be said to have been liberated from the original gas. The overall height of the flame, that is, from the port exit to the top of the outer cone, should be such that just the tips of flame be allowed to scrub the under side of the vessel. When yellow flickerings in intermittent flashes are distinguishable in the flame, the probability is that these are caused by fine dust or dirt particles rather than by insufficient air. Permitting the flame height to be too great will result in carbon monoxide due to incomplete combustion, there being insufficient time for all of the secondary air required to come in contact with the burning gases. This circumstance ably illustrates why in designing burners, provision should be made for the admission of as much primary air as is possible, inasmuch as the greater the per cent of primary air, the less secondary air required, and hence, the shorter the overall flame with consequent lessened chances for resultant carbon monoxide.

Now we are arrived at the excess secondary air phase, which was previously defined. That any air over and above that required to

previous footnotes, access could profitably be had to "Mathematical Calculation of the Energy of Flow of Gas, of Injector Action and Gas Spud in Gas Burners," by W. Schlechtriem in American Gas Journal, issues of December, 1929, and January, 1930, "Gas Burners; Their Design and Characteristics," by G. B. Shawn in American Gas Journal, issue of April, 1930, and "Gas Burner Design," by Weaver, Eiseman and Smith in American Gas Journal, issues of May and June, 1931.

The U. S. Bur. of Stand. recommends in Cir. No. 394 as follows:

a) Distance from tip of orifice to throat at narrowest point be twice that of inside throat diameter.
b) Distance from throat to base of burner head be not less than 6 times that of throat diameter.
c) Throat area be equal to 40% of total port area.
d) Net effective air shutter opening be at least 1.25 times the total port area.

By process of trial and error these ratios have been found to be best in prompting proper entrainment and mixing of the primary air and gas.

[6] Combustion involved in the inner cone is generally accepted as a process called hydroxylation. By means of this phenomenon, explanation is offered that the hydrocarbons literally decompose with added O_2, first into unstable, "oxygenated" compounds of alcohol, and then into an aldehyde with, as Haslom and Russell state, "the first addition of oxygen to the hydrocarbon molecule gives the hydroxyl group (-OH) characteristic of alcohol." The process than progresses with the further separation into CO and H_2, which in turn combine with secondary air to the ultimate products or CO_2 and H_2O.

(Continued from page 47)

supply oxygen requisite to supporting combustion, cannot enter into the process actively is obvious to all. This excess secondary air, therefore, does not serve any useful purpose. But, since excess air, if present, is intermingled with the products of combustion, such superfluous air acquires the temperature of the products, thus lapping up heat, which is difficult, if not impossible, to recover. Excess air might be said to dilute the temperature of the products of combustion, thereby tending to reduce the heat usefully recovered in the cooking operation[7]. This excess secondary air is at present one of the chief sources of thermal loss. Methods of controlling secondary air by means of specially designed drip trays and semi-closed tops will be discussed in the next article.

Several observations are still in order with respect to the burner ports. The distance between the ports must be such that the flame jumps rapidly and surely from port to port in igniting. Secondly, the area of each port must be large enough so that the amount of gas will not be so great as to produce a flame excessive in length. Next, the port must be so drilled and the hole of sufficient depth so that gas will flow outward without undue turbulence and prevent a streamlined, stable flame. And still again, the area must be such that the gas velocity will at least equal, but not greatly exceed, the so-called "ignition velocity" of the gas. This latter forbidding term has to do with the rate of flame propagation[8], or the speed with which flame travels or burns (sometimes measured with gas mixed with known amounts of air in a 1" tube of given length by determining the time taken for the flame to progress from end to end.) The ignition velocity in an actual burner is somewhat less than the theoretical rate of flame propagation, but these are rather technical considerations apart from sales work. If ports become clogged from "boil-overs" or "spill-overs," the air-gas ratio is disturbed and there is a tendency toward elongated flames. Ports must be freed of any such obstructions.

As complex as the design aspect of burners is, if you have gained the impression from the foregoing that extensive scientific study has been undertaken by the various interests wedded to the Industry, much has been accomplished. Startling as the intricacies of the problem might be, the mechanical field practice is relatively simple. Investigations have been costly and productive of progress—in the words of the Prophets, "d—— clever, these Chinese." Every reason exists to confirm the belief that research in utilization will continue to keep the Gas Industry in a more than competitive position. The more one ponders the strengths and vicissitudes of the Gas Industry the deeper the appreciation of the supreme importance of the prosaic top burner on the domestic range.

[7] *One point that is confusing to many gas men is why even though it makes for better thermal efficiencies to design a burner to entrain a high per cent of primary air, that in adjusting burners in the field it is generally regarded that the soft flame, or rather rich mixture, is preferable. As paradoxical as this may appear, the statement is nevertheless true. Designing burners for high primary air contemplates a reduced secondary air supply with consequent increased efficiency. Conversely with the actual burner, the setting of the air shutter to accommodate low primary air results in a longer flame, which in itself, tends to exclude excess secondary. Caution must be exercised in setting for too soft a flame, because an increase in gas pressure might be productive of an overly rich mixture with inherent CO dangers.*

[8] *The characteristics of flames are appreciably influenced by the "ignition velocities" of the gases being burned. Of the primary gases, hydrogen has the fastest rate of flame propagation, hydrocarbons the slowest (approximately 15% that of H_2) and carbon monoxide in between. For this reason, manufactured gas burns much more rapidly than natural gas and with a more clearly defined flame.*

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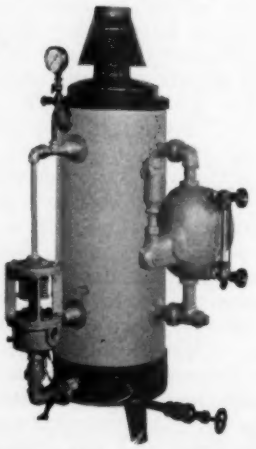

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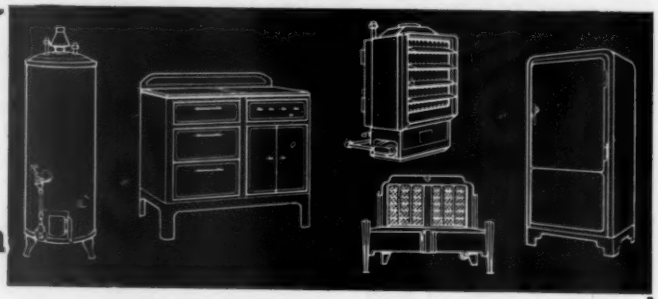

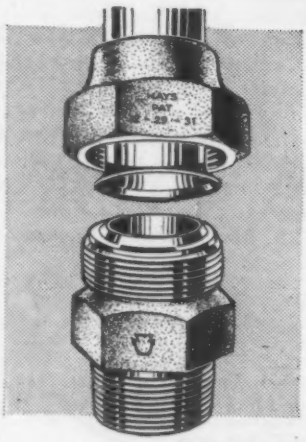

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Pipe Corrosion and Coatings

(Continued from page 16)

been found where the pipe was completely submerged in water. The inference must not be made from this statement that wherever a pipe is submerged corrosion will be severe, but rather that when a main must be submerged, careful consideration of all factors is important. Also the important corrosive factor may not be due to the water in which a main is submerged, but after submersion currents carried by the pipe may flow from the pipe into the water, greatly accelerating corrosion.

Pure water would not be a source of sufficiently severe corrosion to require protection. The limit of deterioration in pure water would be the maximum ability of water to dissolve the metal. Moisture or water is primarily the vehicle which conveys corrosive agents to a metal, although curiously, many of the agents which would not in themselves be corrosive become so through association with moisture, the water actually being a participant in the reaction but remaining unchanged in volume in many instances, due to the disassociation of elements forming water being reversible in the presence of oxygen. This association of moisture with corrosive agents may be viewed as a contamination of the water and may occur from sources too numerous to catalog. If it is possible to recognize the sources of contamination, their elimination as corrosive agents is frequently possible. Air pollution in the vicinity of specific industries is an occasional source of corrosive agent as rain scrubs the atmosphere.

Material used for the filling in of land, refuse and waste and other artificial disturbances of nature may be the sources contaminating water which eventually comes in contact with mains. Consideration of the sources of water contamination are only of vital importance where metals have been installed without any effective protection. A study of water contamination is frequently valuable in indicating the difficulties encountered in localized areas after unprotected lines have been economically justified over extensive areas.

The conductivity of a soil is altered with changes in the salt content. The complexity of corrosion studies is again indicated when considering that among other things, moisture also affects soil conductivity. Practically all factors which increase the conductance of a soil also directly or indirectly cause corrosion. While this statement indicates the importance of conductance, experience has indicated that other factors in addition to conductance must be considered to predict the corrosiveness of soil with a greater degree of accuracy.

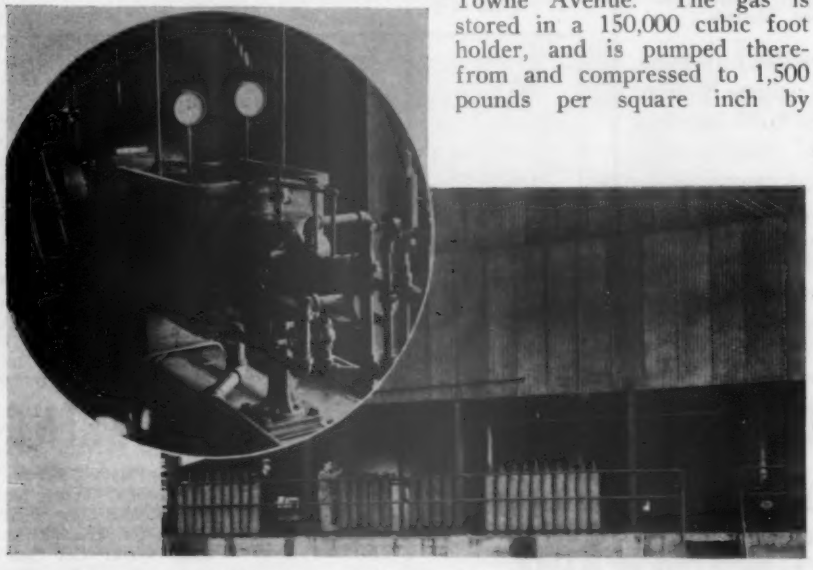
(Part III will appear in September issue)

Los Angeles Utility Provides New Source of Manufactured Test Gas for Pacific Coast A.G.A. Testing Laboratory

As a result of the recent changeover from manufactured to liquefied petroleum gas service in the town of Escondido, California, it has been necessary for the Pacific Coast Branch of the American Gas Association Testing Laboratories to seek elsewhere for a source of manufactured gas suitable to its purposes in testing gas appliances and their accessories. Arrangements have, accordingly, been completed with the Southern California Gas Company in Los Angeles for the new supply.

The accompanying illustration presents a general view of the Pacific Coast Branch Laboratories' set-up at the Santa Fe plant of the Southern California Gas Company for compressing stored manufactured gas into cylinders for subsequent trucking to the Testing Laboratory on Towne Avenue. The gas is stored in a 150,000 cubic foot holder, and is pumped therefrom and compressed to 1,500 pounds per square inch by the compressor at the right of the general view. The resultant high pressure gas is forced through the overhead line to a manifold feeding the central bank of ten cylinders. Five are filled at once. Each cylinder draws ninety cubic feet of gas from the holder. Fifty cylinders in all are filled at each trip. In the compression process there is a loss in the heating value of the gas of approximately 29 Btu. per cubic foot.

The inset close-up of the compressor unit shows the water cooling provisions and rugged construction required for packing a month's supply of test gas into one truck load of high pressure cylinders.



Compressed Manufactured Gas for A.G.A. Testing Laboratories

National Radiator Corp., Forms New Air Conditioning Co.

In order to provide a single source from which to procure coordinated equipment for year round conditioning of air within homes, specialty shops, and small commercial buildings, the National Radiator Corporation announces the formation of a subsidiary company, National Air Conditioning, Inc., with sales offices at 101 Park Avenue, New York City.

Charles P. Culbert has been elected vice president and general manager of National Air Conditioning, Inc., and will be located in New York. Among other appointments, is that of L. N. Hunter who becomes vice-president in charge of engineering for the new company.

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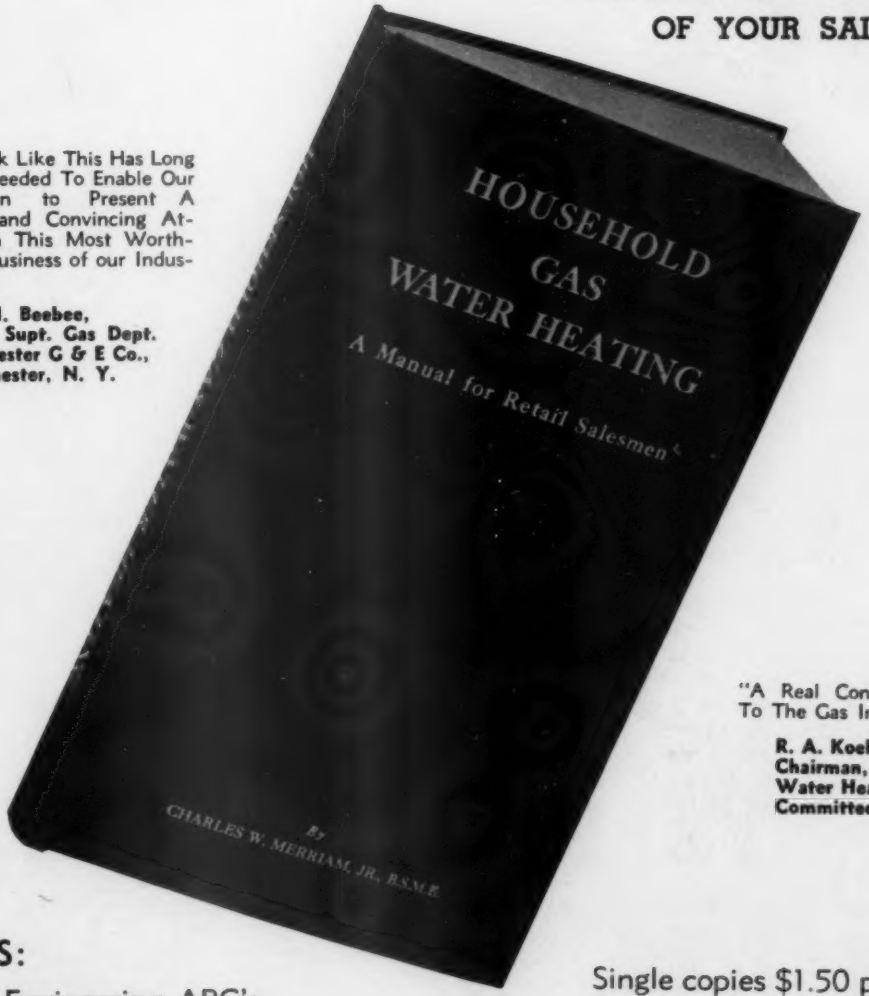

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